W-11 TM-11-1

THREE

18S-4

AIRCRAFT

TRANSMITTER-RECEIVER

KT-380

INSTRUCTION BOOK

INSTRUCTION BOOK

for

18S-4 TRANSMITTER-RECEIVER

Manufactured by

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

520 9436 00

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GUARANTEE

The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory in Cedar Rapids, Iowa, transportation prepaid, provided that the foregoing shall not be applicable to.

(a) Equipment or accessories as to which notice of the claimed defect is not given Collins within one year from date of delivery;

(b) Equipment and accessories manufactured by others than Collins, tubes and batteries, all of which are subject only to such adjustment as Collins may obtain from supplier thereof;

(c) Equipment or accessories which shall fail to operate in a normal or proper manner due to exposure to excessive moisture in the atmosphere or otherwise after delivery, any such failure not being deemed a defect within the meaning of the foregoing provisions.

Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins.

Notice of any claimed defect must be given to Collins prior to return of any item. Such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. Upon receipt of such notice, Collins will promptly advise respecting return of equipment. Failure to secure our advice prior to the forwarding of goods for return may cause unnecessary delay in the handling of such merchandise.

No other warranties, expressed or implied, shall be applicable to said equipment, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any cause.

HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable:

Address: Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

Information Needed:

(A) Quantity required
(B) Part number of item
(C) Item number (obtain from Parts List or Schematic Diagram)
(D) Type number of unit
(E) Serial number of unit
(F) Serial number of equipment

HOW TO RETURN MATERIAL OR EQUIPMENT

If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in handling of your returned merchandise.

Address: Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

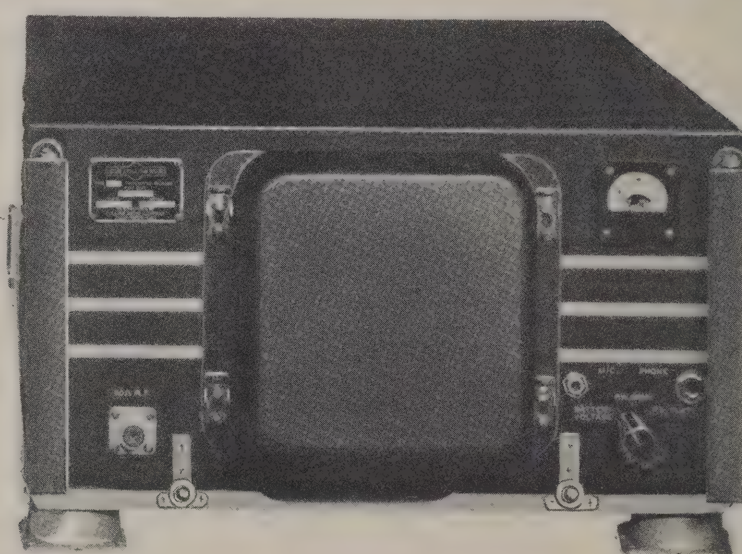
Information Needed:

(A) Date of delivery of equipment
(B) Date placed in service
(C) Number of hours in service
(D) Part number of item
(E) Item number (obtain from Parts List or Schematic Diagram)
(F) Type number of unit from which part is removed
(G) Serial number of unit
(H) Serial number of the complete equipment
(I) Nature of failure
(J) Cause of failure
(K) Remarks

180K

520 3115 00
SHOCKMOUNT

CR1A crystal



18S

504 5203 005
SHOCKMOUNT

FIGURE 1-1 MODEL 18S EQUIPMENT

SECTION I

GENERAL DESCRIPTION

1. GENERAL.

The Collins Model 18S-4 medium frequency aircraft communication installation is designed to cover the frequency range of 2 to 18.5 mc on any one of 10 separate channels. By use of two frequencies not more than 1% apart in each channel, a total of 20 frequencies can be available.

Constructed of two main units, the 18S-4 Transmitter-Receiver and the 180K-3 Antenna Matching Network, the equipment is designed to be remotely controlled from the pilots or radio operators position.

The 180K-3 can be mounted a considerable distance from the 18S-4 in position compatible to aircraft weight distribution and space limitations with negligible r-f energy loss in interconnecting coaxial cable. It is recommended that the 180K-3 be mounted to minimize the antenna lead-in length thus permitting the maximum amount of r-f energy to be radiated outside the aircraft when transmitting.

Frequency change is accomplished by means of pre-tuned circuits selected with tap switches in all tuned stages except the antenna matching network where a Collins Autotune unit is employed to give the necessary variable adjustment.

2. CONSTRUCTION AND MOUNTING.

The transmitter-receiver unit slides into an aluminum cabinet and is secured by Dzus fasteners in the rear. The complete assembly is then clamped into a rubber mounted shockmount.

The antenna matching network is to be compression or suspension mounted and may be located at the point of antenna entrance. The antenna matching network is constructed to permit the mounting frame to be assembled to the chassis for either type mounting by screwing it to the bottom or top side.

3. ELECTRICAL DESCRIPTION.

a. TRANSMITTER SECTION. - The transmitter employs a pentode crystal oscillator circuit with provisions for 20 crystals which are selected by the band change tap switch and the crystal select relay. The oscillator is followed by a pentode isolation stage which drives a beam type buffer-doubler tube. The buffer-doubler drives the beam power amplifier tube to 100 watts nominal output on all frequencies. The plate circuit of the buffer-doubler tube is tuned by 10 permeability tuned coils selected by a tap switch. It is intended that each coil shall tune to two frequencies not more than 1% removed from each other if more than 10 frequencies are employed. The plate circuit of the power amplifier consists of an "L" network which reduces the impedance of the output circuit to 52 ohms. This network is also pre-tuned by tap switch selected capacity and inductance values.

The final amplifier plate and screen are modulated by a pair of high-mu triode tubes operating in Class B service. The modulator tubes are driven by a pentode power tube which is excited by the microphone output.

b. RECEIVER SECTION. - The receiver portion of this equipment is a crystal controlled superheterodyne, employing one stage of pentode r-f amplification, a pentagrid converter excited by a dual pentode crystal oscillator tube, 3 stages of pentode 455 kc intermediate frequency amplification, a 1N38 fixed crystal detector, a dual diode for noise limiter and AVC, a dual triode audio amplifier sidetone oscillator, a dual pentode in a push-pull audio output stage and a dual triode as a CW beat frequency oscillator.

c. ANTENNA MATCHING NETWORK. - The Type 180K-3 Antenna Matching Network is designed to provide maximum transfer of energy between a 52 ohm coaxial transmission line and an aircraft antenna 45 feet or more in effective length. The network includes a tapped series tuning coil, a continuously variable inductor (variometer), a shunt tuning coil and mounting panels for input and output capacitors. A five-section network switch is used to connect the circuit elements in the desired configuration for each channel. This switch and the variometer are controlled by a Collins Autotune mechanism to provide remote channel selection in synchronism with the 18S-4 transmitter. To assist in determining the proper network for each channel and making final adjustments, meters indicating the degree of mis-match (standing wave ratio) and transmitter final amplifier plate current are provided.

d. ACCESSORIES. - In order to complete the installation, the following accessories will be required: An antenna of 45 feet minimum length, a primary source of power capable of supplying 28 volts at 38 amperes continuous, a remote control panel (see list of parts in Section 3), a suitable length of RG-8/U coaxial line and connectors, a suitable length of interconnecting cable for connection to control circuits, power leads, a carbon microphone equipped with a push-to-talk button, and 500 ohm headphones or other audio reproducing devices. The audio output system of this set is particularly designed for use with Jack-Box type bridging and mixing amplifiers.

4. LIST OF MAJOR UNITS.

The following list of equipment can be furnished by the Collins Radio Company for an 18S-4 aircraft installation.

Collins Type No.	Description	Dimensions (WxLxH)	Weight (lb)
18S-4	Transmitter-Receiver	15-1/2 x 21-1/2 x 7-3/4	55.0
504 5203 005	Shockmount for 18S-3	16-1/16 x 24-1/4 x 4-1/8	4.0
180K-3	Antenna Matching Network	10-1/8 x 10-7/8 x 7-3/4	12.8
520 3115 00	Shockmount for 180K-3	10 x 10-5/8 x 1-1/2	1.0
020 4060 00	Carbon microphone, cord, and plug 40 ohms resistance	-	.45

FIGURE 1-2 MODEL 18S TRANSMITTER-RECEIVER UNIT

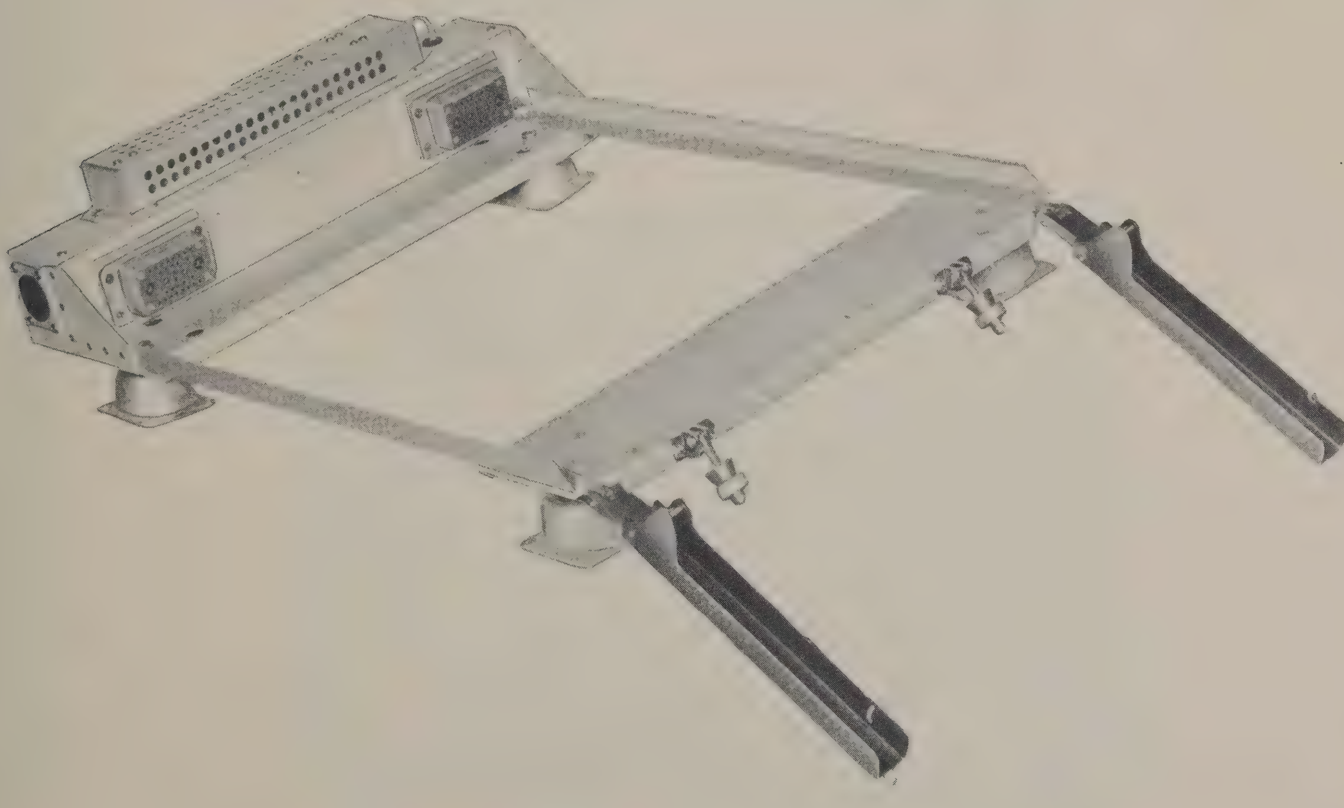


FIGURE 1-3 SHOCKMOUNT FOR 18S

Figure 1-4 Model 180K Antenna Matching Unit Mounted in Beechcraft D18S

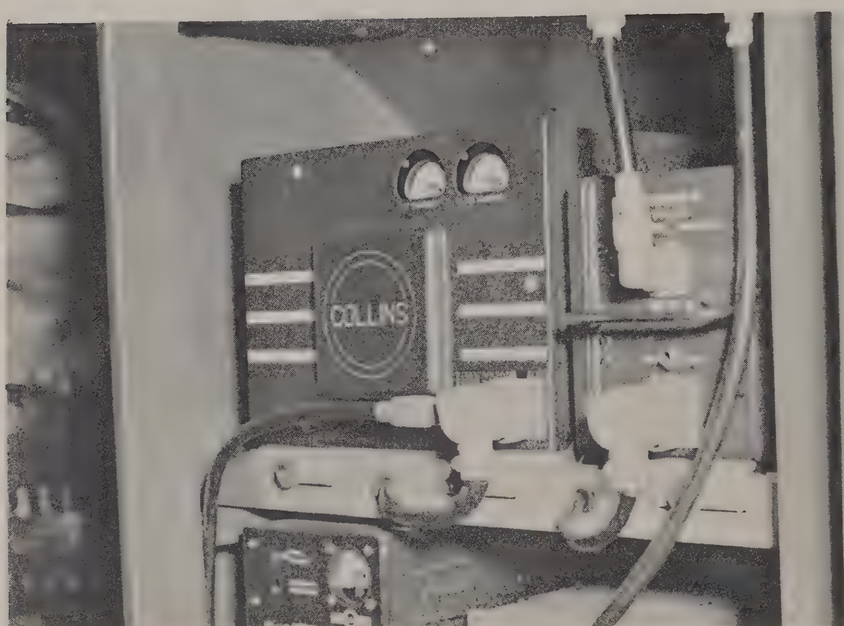


Figure 1-5 Model 180K Antenna Matching Unit Mounted in Douglas DC-3

Collins Type No.	Description	Dimensions	Weight (lb)
425 0006 00	52 ohm coaxial transmission line		
457 9006 00	Coaxial line fittings (2)		
424 0006 00	Power cable to antenna matching network		
371 0012 00	Plug connector for 180K-3 power cable		
	"Keep Alive" resistor 5.1 ohms		
	Kit of remote control parts		

5. REFERENCE DATA.

a. TRANSMITTER.

1. Frequency Range - 2.0 - 18.5 mc
2. No. of channels - 10
3. No. of pre-set frequencies - 20
4. Frequency control - quartz crystals
5. Type of emission - AM telephone (A-3), CW (A-1).
6. Modulation capability - 100%
7. Frequency Response - Within 5 db between 300 cps and 2500 cps at 50% modulation.
8. Distortion - Less than 6% at 1000 cps with 90% modulation of carrier.
9. Output - 100 watts nominal to the antenna matching network on all frequencies.
10. Power Unit - Self contained dynamotor.

b. RECEIVER.

1. Frequency Range - 2.0 - 18.5 mc
2. No. of channels - 10
3. No. of pre-set frequencies - 20

4. Frequency control - quartz crystals

5. Type of reception - AM telephone (A-3), CW (A-1)

6. Output - 100 MW nominal

7. I-F frequency - 455 kc

8. Output impedance - 500 ohms

9. AVC Characteristics - Constant output within 2 db with from 10 microvolts to 0.5 volt r-f input across 52 ohm line input connector. The receiver will not block with up to 1.5 volts r-f input.

10. Power source - 28 volt battery for both plate and filament.

6. VACUUM TUBE COMPLEMENT.

Symbol Designation	Vacuum Tube Type	Function
V101	28D7	HF Osc (Receiver)
V102	6BA6	Preselector
V103	12BE6	Mixer
V104	6BA6	1st i-f amp
V105	6BA6	2nd i-f amp
V106	6BA6	3rd i-f amp
V107	12AL5	Noise limiter-AVC
V108	12AU7	Audio driver - Sidetone oscillator
V109	28D7	Audio power amp
V110	12AU7	BFO
V201	1625	Buffer-doubler
V202	813	Power amp
V203	6V6	Mod. driver
V204	811	Mod.
V205	811	Mod.
V206	6AG7	Isolation amp.
V207	12AU6	Transmitter oscillator

SECTION 2

THEORY OF OPERATION

1. MECHANICAL THEORY.

a. GENERAL. - The equipment is constructed in two major units, the transmitter-receiver unit and the antenna matching unit. The transmitter-receiver unit is 1-1/2 ATR in size and is equipped with facilities for mounting in a shock-proof base. The antenna matching unit is in a separate cabinet and is base mounted.

b. AUTOMATIC TUNING MECHANISMS.

(1) TRANSMITTER-RECEIVER.

(a) CHANNEL-SELECTOR. - The 18S-4 tuning circuits consist of pretuned coils chosen by tap switches S101A, B, C, D, E, F, J, K, M and N ganged on a single shaft. These tap switches are driven by a permanent magnet motor through a gear train. The motor is cradled in two bearings so that the movement of the frame due to excessive torque can be used to operate an overload switch, S102, should the motor load, for any reason, become too great. Because of the very high gear ratio between the motor armature and the channel switch pies, excessive loading by the switch pies could cause damage to the associated gears. This overload switch is equipped with a set of contacts which short circuit the motor armature to affect a magnetic brake thus preventing the armature coasting.

In operation, the position at which the channel change switch stops is determined by the position of the band selector switch in the control unit. Stopping the channel change switch is actually a function of the open segment of switch pie S101H, however, simultaneously with the reaching of the open segment in S101H, a pawl is made to drop in a notch on a notched wheel which is secured to the channel switch shaft very accurately and overtravel is positively prevented. The function of the pawl and notched wheel is not to stop the channel switch but to positively prevent overtravel once the open segment of switch pie S101H is found. Refer to paragraph 2a. for a description of the electrical portion of the channel change mechanism.

(2) ANTENNA MATCHING NETWORK.

(a) REMOTE CONTROL SYSTEM. - The remote control system of the Type 180K-3 Antenna matching network consists of a motor-driven Collins Autotune mechanism which sets the network selecting switch S501 to the channel chosen by the remote control box selector switch and sets the variometer L501 to the position determined for the selected channel. An interlock system prevents the associated transmitter from operating during the period of channel change. A simplified diagram of the remote control system is shown in Fig. 2-4. A detailed drawing of the Autotune mechanism is shown in Fig. 2-1.

(b) AUTOTUNE MECHANISM. - In this equipment the Autotune mechanism performs two functions; namely, (1) setting the network switch to the selected channel position, and (2) setting the variometer to its proper position

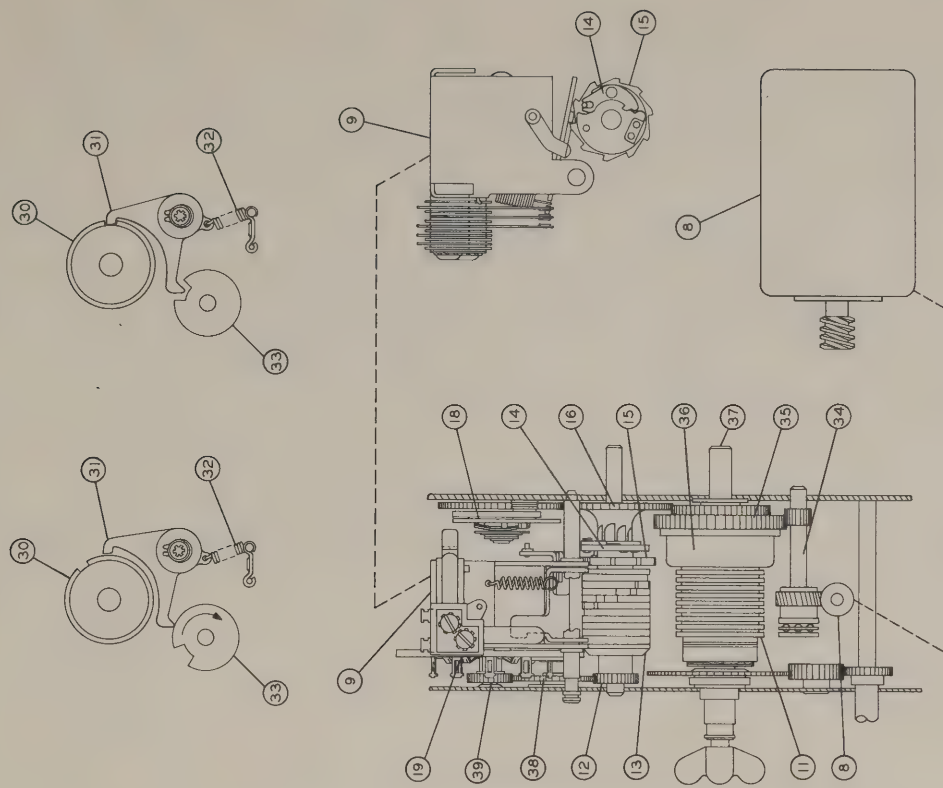
for the selected channel. Referring to Fig. 2-3, the Autotune mechanism consists of a d-c motor, B502, a circuit-seeking switch, S503, a relay K501, a limit switch, S504, an Autotune control head, two friction clutches a limit switch cam, and a ratchet drive mechanism. Relay K501 performs three separate functions, operating a group of electrical contacts, controlling the engagement of the ratchet drive mechanism and controlling a stop arm which controls the rotation of the limit switch cam.

The setting of the network switch, S501, is performed by the circuit-seeking function of the Autotune. The rotor of the circuit-seeking switch S503, is driven by the motor through the relay-controlled ratchet mechanism. Referring to Fig. 2-3, 28 volts is applied to relay K501 through the contacts of limit switch S504. When the remote control switch is set to a new position, the negative terminal of the relay coil is grounded. The relay, being actuated, operates its set of contacts, sets the limit switch cam stop arm and causes the ratchet drive to be engaged. One set of contacts on K501 starts motor B502; the other set acts as a holding contact so that when limit switch S504 is released, the relay remains actuated until its grounding circuit is broken.

The motor, being started, drives the limit switch cam until the cam strikes the relay-operated stop arm; the cam then stops and its drive clutch slips. The motor simultaneously drives the rotor of the circuit seeking switch through the ratchet drive. The rotor rotates until its position is identical to that of the remote control switch; at this point the relay grounding circuit is opened and the relay drops out. This releases the ratchet drive and the switch rotor stops in the channel position selected by the remote control switch. Since the network selecting switch S501 is linked mechanically to the shaft of the circuit seeking switch rotor, it is automatically set at the proper channel. This completes the positioning of the network selecting switch, S501.

The angular position of the variometer L501 is controlled by the Autotune control head which consists of 10 notched discs or stop rings mounted on a shaft, but separated from each other by keyed washers so that the angular position of each stop ring can be adjusted without disturbing the position of the other stop rings. Associated with each stop ring is a pawl having two teeth, one of which can engage the stop ring notch and stop its rotation. The other teeth of the pawl rides on a pawl-selecting cam drum which consists of 10 notched discs similar to the stop rings, but mounted on a shaft in spiral fashion, so that the angular position of the cam drum determines which pawl shall engage its stop ring. All pawls except the one selected by the cam drum are lifted free of the stop ring stack. The cam drum is driven in synchronism with the circuit seeking switch, so that when this switch "finds" its channel, the corresponding stop ring pawl is selected.

When the circuit seeking switch "finds" its channel, and the relay drops out, the motor continues to run, its circuit being completed through



Item	Circuit Function	Description
7	Autotune Head	496B-1
8	Motor Assembly	Motor, Gear and Bracket
9	Relay	Special
11	Stop Ring Shaft Assembly	Stop Ring Shaft, Drum, Band, Gear, Clutch, and Ring Assembly
12	Cam Shaft Assembly	Cam Shaft Assembly, and Gear #1
13	Cam Drum Pin Assembly	Pin Assembly and Drum Assembly
14	Ratchet Latch Assembly	Hub, Pawl, Pins, Spring and Rivet
15	Ratchet Wheel Assembly	Wheel and Pin
16	Cam Drive Gear Assembly	Gear and Bearing
17	Pawl Assembly	Shaft Assembly, Pawl Assembly, Springs, Anchor, and Pins
18	Limit Switch Clutch	Plate, Spring, Spacer, Ring, Gear, and Shims
19	Seeking Switch	10 Position Switch Pie
20	Bearing	Ratchet Drive Gear Bearing
21	Bearing	Thrust, Upper Casting
22	Bearing	Rear

Item	Circuit Function	Description
23	Bearing	Seeking Switch
24	Locking Bar Assembly	
25	Ball Bearing	Rear
26	Ball Bearing	Front
27	Oilite Bearing Assembly	Upper Casting Bearing
30	Stop Ring	
31	Pawl	
32	Pawl Spring	Coil
33	Cam Drum	
34	Line Shaft	Line Shaft, Worm Gear and Spur Gear
35	Slip Clutch Spur Gear	
36	Slip Clutch	
37	Tuning Element Shaft	
38	Seeking Switch Idler Gear	
39	Seeking Switch Drive Gear	

Figure 2-1 Autotune Function Drawing

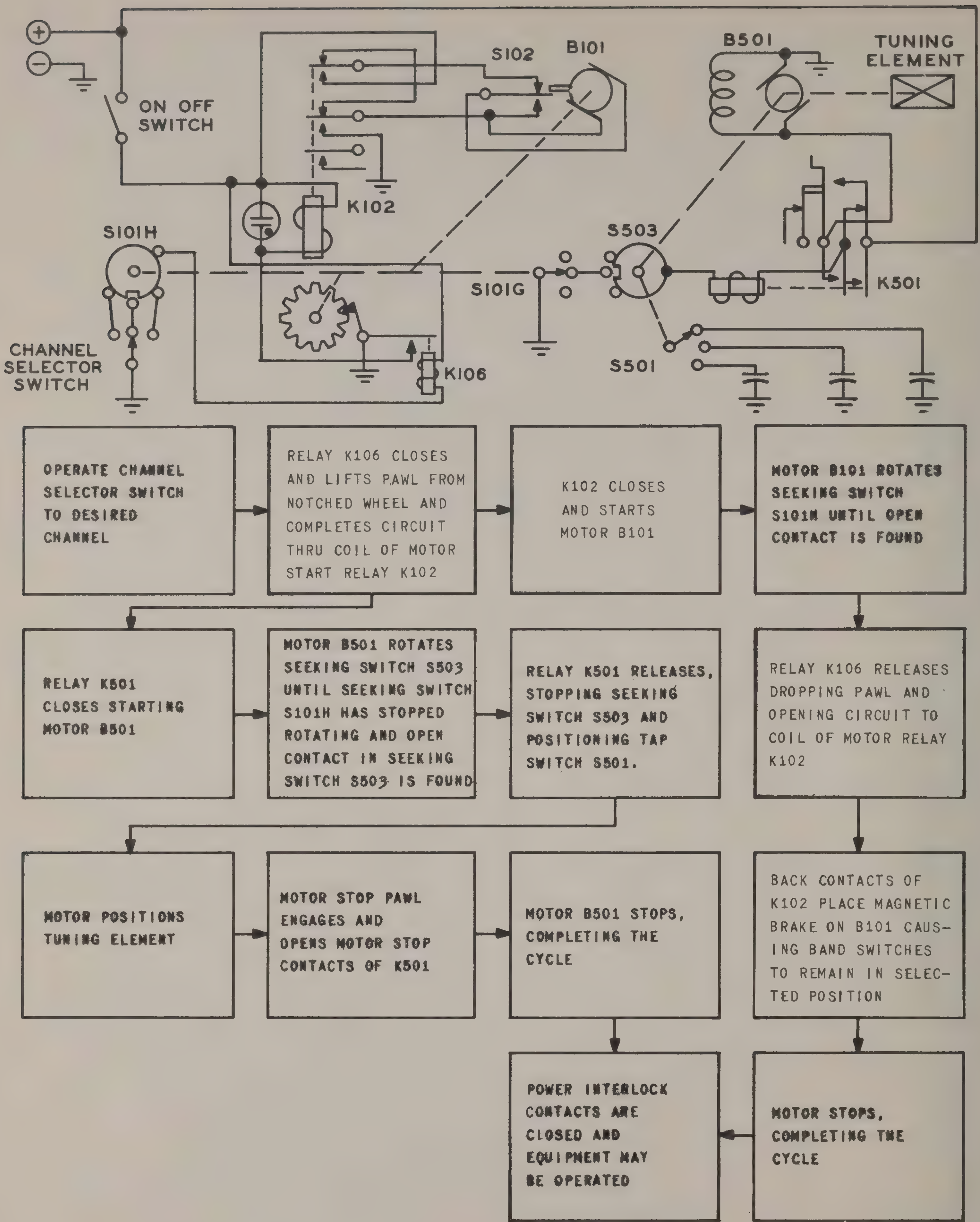


Figure 2-2 Automatic Tuning Sequence of Operation

the contacts of limit switch S504. The motor continues to rotate the shaft of the stop ring stack and, since the limit switch cam stop arm is released, the limit switch cam begins to rotate again. The stop ring stack rotates until the selected pawl engages its stop ring; this stops the rotation of the stop ring stack and the clutch connecting it to the motor slips. The limit switch cam continues to rotate until it engages the limit switch contacts, stopping the motor and completing the Autotune channel-selecting cycle. A pair of contacts on the limit switch are wired so as to prevent application of power to the associated transmitter during the period of channel selection. The entire cycle described is performed in approximately 2 seconds under conditions of normal temperature and voltage.

In the installation adjustment procedure, the variometer is manually adjusted to the proper position for best antenna matching for each channel. These adjustments automatically set the positions of the stop rings so that the Autotune mechanism will thereafter reset the variometer to its proper position for each channel.

Refer to paragraph 2., b. in this section for the description of the electrical circuits involved in operation of the Autotune Unit.

2. ELECTRICAL THEORY.

a. TRANSMITTER-RECEIVER CHANNEL CONTROL CIRCUITS. - The band switching mechanism in the transmitter-receiver unit consists of a system of motor driven ganged switches which select crystals, coils, output capacitors and coil taps.

All of the band changing switches are ganged to one shaft and, in order that the driving motor shall stop and position the switches accurately, it is made to stop at the exact moment the tap switches are in the selected position by removing the 28V driving power and by shorting the armature coil to obtain the affect of a magnetic brake.

Refer to figure 2-2. The band change motor is controlled by relay K102 which is in turn controlled by relay K106. Relay K106 in addition to controlling K102, lifts the pawl from the notched wheel when energized. In operation, when the channel selector switch is turned to a new channel, a ground is placed on one end of the coil of relay K106 by the circuit through the channel selector switch and switch pie S101H; the other end of the coil on this relay being connected to the 28 volt source. Upon being energized, relay K106 lifts the pawl from the notched wheel, which is pinned to the channel switch shaft, and then completes the coil energizing circuit for relay K102 to start the channel change motor. The motor drives the channel change switch S101 until the notch in the blade of switch pie S101H finds the controlling wire and opens the coil circuit to relay K106 with the result that the coil circuit to motor relay K102 is opened and the overtravel pawl drops into a notch in the notched wheel. Opening the circuit to the coil of motor relay K102 removes the driving power to the motor and, at the same time, brakes the armature of the motor to a quick stop by short circuiting the armature winding through back contacts on the relay (K102). Should

the load on the motor become too great for any reason during the band change process, the frame of the motor will rotate slightly and operate interlock switch S102 which will turn off the power to the motor and also short circuit the armature winding to immediately stop the motor thus preventing possible damage to the motor gears. This same action will result if the band change switch shaft doesn't stop due to the contacts of motor relay K102 not functioning properly; in this case, the pawl and notched wheel will furnish the drag to result in the motor frame rotating to operate the interlock switch.

b. ANTENNA MATCHING UNIT CHANNEL CONTROL CIRCUITS. - The channel selector switch for the AUTOTUNE unit in the 180K unit is switch section S101G in the transmitter-receiver unit. This switch section is ganged with the band change switch, therefore, it is automatically set to the proper position when the band change mechanism has finished operating. The seeking switch, S503, is mechanically coupled to the AUTOTUNE unit and serves to electrically synchronize the cam drum with the channel selected. The seeking switch shaft is geared to the rotors of the selector switches, S501 A-E.

Relay K501 has motor-start, armature-operated contacts and motor-stop, cam operated contacts. In operation, the motor start contacts are closed by the circuit from the grounded contact on selector switch S101G, through the corresponding contact on seeking switch S503, the coil of relay K501, the NC contacts of the limit-switch to the positive side of the battery. As soon as relay, K501 is operated, the motor contacts close and the motor starts to drive the AUTOTUNE mechanism. The limit-switch cam operating clutch is released by the relay and the clutch begins to turn, allowing the limit-switch contacts to close. The seeking switch rotates until the notch in the seeking switch rotor contact breaks the relay coil circuits. The relay releases and trips the ratchet mechanism which stops the rotation of the seeking switch exactly on the channel selected. The limit-switch contacts maintain the motor circuit and the tuning element continues to rotate along with the limit-switch operating clutch. When the seeking switch stops rotating, the AUTOTUNE cam drum also stops rotating, allowing the proper pawl to drop into place in the AUTOTUNE cam drum. The stop ring shaft which is coupled to the tuning element rotates until the pawl drops into the depression in the stop-ring which stops the tuning element in the proper position after which the drive clutch slips. The limit-switch cam operating clutch continues to rotate until the cam is again engaged and the limit-switch contacts are opened stopping the motor and completing the cycle.

c. POWER CONTROL CIRCUITS. - See figure 2-3. This equipment has been designed to operate from a 28.0 volt direct current power source. The filaments of the tubes are connected in series parallel across the power source. All power control is done remotely. Applicable circuits for power control switches are shown in figure 2-3. Heater power is applied to the receiver tubes and to the oscillator and speech amplifier tubes of the transmitter when the ON-OFF switch is placed in the ON position. The receiver tubes obtain plate voltage from the 28.0 v power source, also, when the ON-OFF switch is in the ON position. The dynamotor solenoid is energized by operation of the antenna relay on phone

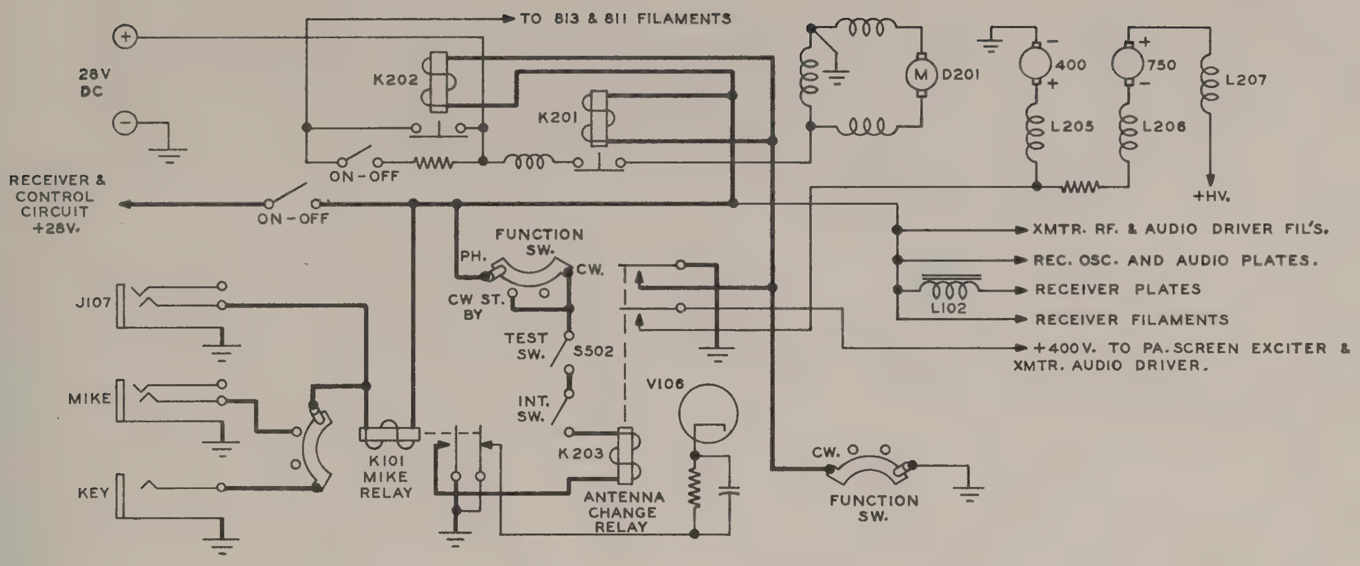


Figure 2-3 Primary Power and Control Circuits

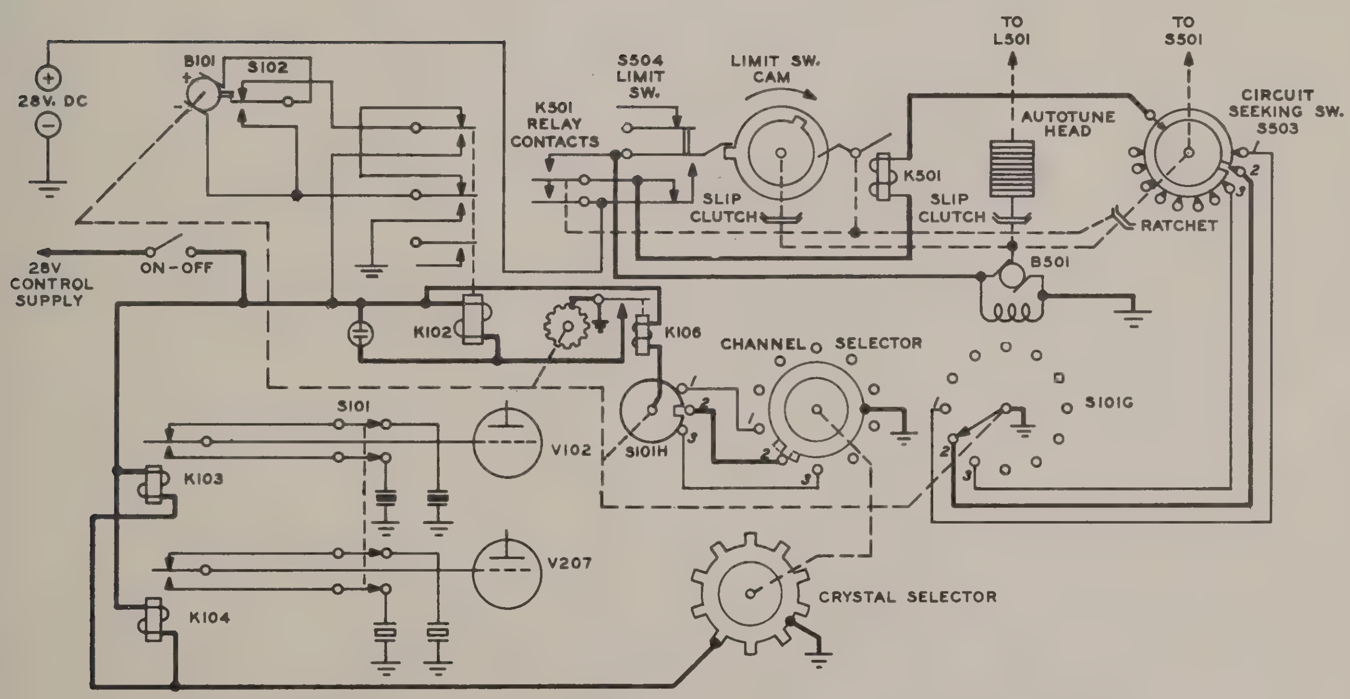


Figure 2-4 Channel Circuit Control Schematic

emission or by operation of the function selector switch on CW emission. After the ON-OFF switch is turned ON, the antenna relay is energized when the microphone relay K101 is operated (by the push-to-talk button or telegraph key.) When CW operation is chosen by the function selector switch in the remote control unit, the dynamotor control solenoid K201 is held in the operated position by a circuit through the contacts on the function selector switch. As a result, the dynamotor operates continually during CW transmission.

In order to minimize power consumption during stand-by periods, the filaments of the 813 power amplifier tube and 811 modulator tubes are energized only when the function selector switch is in the CW position; however, the equipment has facilities for connecting a "keep alive" resistor across the contacts of filament contactor K202 which will allow the PA and Mod. filaments to be partially heated any time the ON-OFF switch is turned ON.

d. TRANSMITTER CIRCUITS.

(1) GENERAL. - Refer to the following block diagram showing the major circuit divisions.

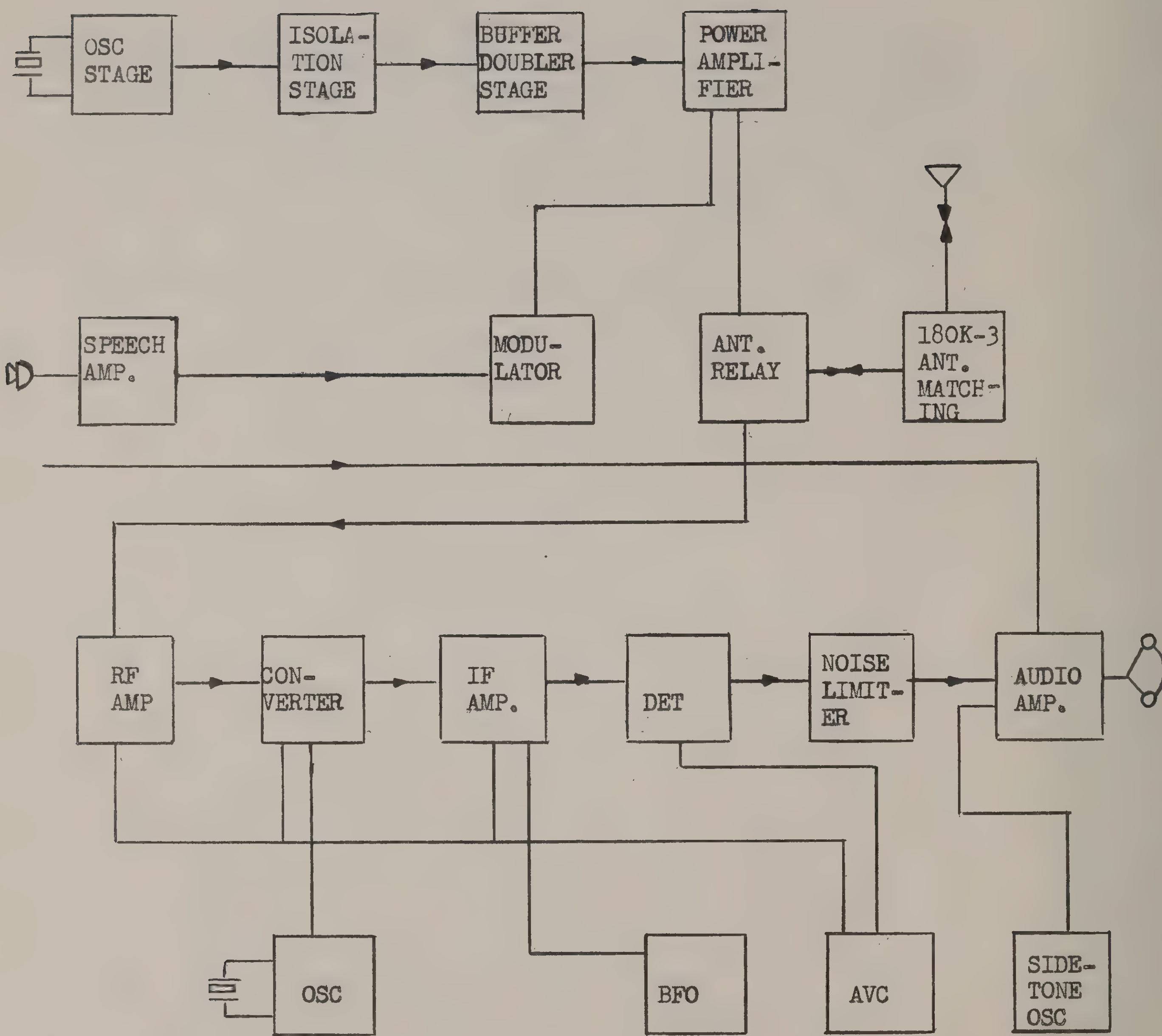


Figure 2-5 Model 18S-4 18OK-3 Equipment Block Diagram

The transmitter r-f section consists of a high frequency crystal controlled oscillator followed by an isolation stage and a buffer doubler stage driving a beam type power amplifier tube. The output of the power amplifier is coupled to the transmission line by a "pi" network.

The audio section of the transmitter consists of a microphone input circuit followed by a speech amplifier driving a pair of modulator tubes which operate in Class B service to modulate the plate and screen of the final amplifier tube.

(2) FILAMENT CIRCUITS. - See figure 2-6. Tubes with 6.3, 12.6 and 10 volt filaments are used in this equipment. A system of series - parallel connections is employed to energize the filaments from the 28 v primary power source. The filaments of all tubes except the 813 and 811 tubes are fully energized when the ON-OFF switch is placed in the ON position. The filaments of the 813 and 811 tubes are energized by operation of relay K202 when the function selector switch is set to the CW position or when the function selector switch is in the PHONE position and the push-to-talk button is pressed. If the optional keep-alive resistor is employed, the 813 and 811 filaments will be partially energized when the ON-OFF switch is turned ON at any time.

(3) HIGH VOLTAGE CIRCUITS. - High voltage for the transmitter section of the Model 18S-4 is obtained from dynamotor D-201 which receives input power from the 28 v power source. The dynamotor has two output windings, one of 400 volts and one of 750 volts. The 400 volt output is applied to the transmitter oscillator, the buffer doubler, the speech amplifier stages and the 813 screen while the 400 volt output and the 750 volt output are connected in series and applied to the modulator and final amplifier plates.

(4) RADIO FREQUENCY CIRCUITS.

(a) EXCITER. - See figure 2-7 channel selector tap switch sections S101F and S101J select any two of twenty transmitter crystals while the crystal choice relay K104 selects the proper crystal from these two. The frequencies of two crystals on the same channel must be within 1% of each other. The crystal oscillator employs V-207, a type 12AU6, in an electron-coupled circuit in which no tuned circuit is required. The plate circuit impedance consists of a coil which is factory-adjusted to provide maximum output at the highest operation frequency used. The oscillator is followed by V206, a type 6AG7, isolation stage and V-201, a type 1625 buffer doubler stage. All frequency multiplying is done in the 1625 plate circuit. Channel selector tap switch section S101E selects the proper transmitter exciter coil for the frequency chosen. The r-f voltage developed by the buffer doubler is coupled to the final amplifier grid through capacitor C206.

(b) POWER AMPLIFIER. - Refer to figure 2-7. V-202, a type 813 beam power tube is employed in the power amplifier output stage of the transmitter, and is always used as a straight amplifier. Bias for the 813 tube is produced by the grid-current voltage drop across resistors R204 and R205 in the grid circuit. The 813 output network is a "pi" section comprised of selected ceramic capacitors and five series-connected, tapped coils and a fixed mica capacitor. The capacitor selection is done by connecting one, or a group of ceramic capacitors to the capacitor selector switch wafer S101-M. Likewise the required inductance is selected by wiring from the necessary coil taps to the inductance selecting wafer S101-K. Switch S101K shorts the portion of the coil to whatever tap the rotor is in contact with. The chart on page 6-3 presents tabular frequency, capacity and coil tap information to match the 813 output impedance to the 52 ohm output. Tap switch section S-101 N provides additional short-circuiting to eliminate self-resonance in the unused portion of the coil.

(5) AUDIO CIRCUITS.

(a) SPEECH AMPLIFIER. - The speech amplifier is designed for use with a carbon aircraft microphone. V-203, type 6V6, is employed in a pentode circuit for the speech amplifier. The microphone is transformer coupled to the grid of the speech amplifier tube and the output of the speech amplifier is transformer coupled to the modulator tubes. A cathode resistor provides bias voltage while the plate voltage is obtained from the 400 volt commutator on the dynamotor.

(b) MODULATOR. - V-204 and V-205, type 811 triode tubes are employed as Class B push-pull modulators to amplitude modulate the plate and screen of the V-202 type 813 power amplifier. The Bias is obtained by connecting the grid returns of the tubes back to the filaments in such a manner as to utilize the average voltage drop across the filaments for bias. The modulators are coupled to the final amplifier plate and screen elements by transformer T201. Plate voltage for the modulator tubes is obtained from the 1150 volt output of the dynamotor.

(c) RECEIVER CIRCUITS. - See figure 2-8.

(1) GENERAL. - The receiver employed in the 18S-4 is a superheterodyne circuit and includes a noise limiter, delayed AVC and crystal controlled high frequency oscillator. In order to eliminate the use of a dynamotor or vibrator plate supply, the receiver has been engineered to use the 28 v power source as plate supply.

(2) R-F AMPLIFIER. - V-102, type 6BA6, pentode tube is used in the radio frequency amplifier stage of the receiver. The input tuned circuit consists of C-126(plus tube input capacitance) and one of ten adjustable slug - tuned coils selected by tap switch S-101D. The 52 ohm r-f input is coupled to the tuned circuit by C-127 which provides a capacitance tap to match the 52 ohm transmission line to the high impedance input of the tube. The tuned circuit is

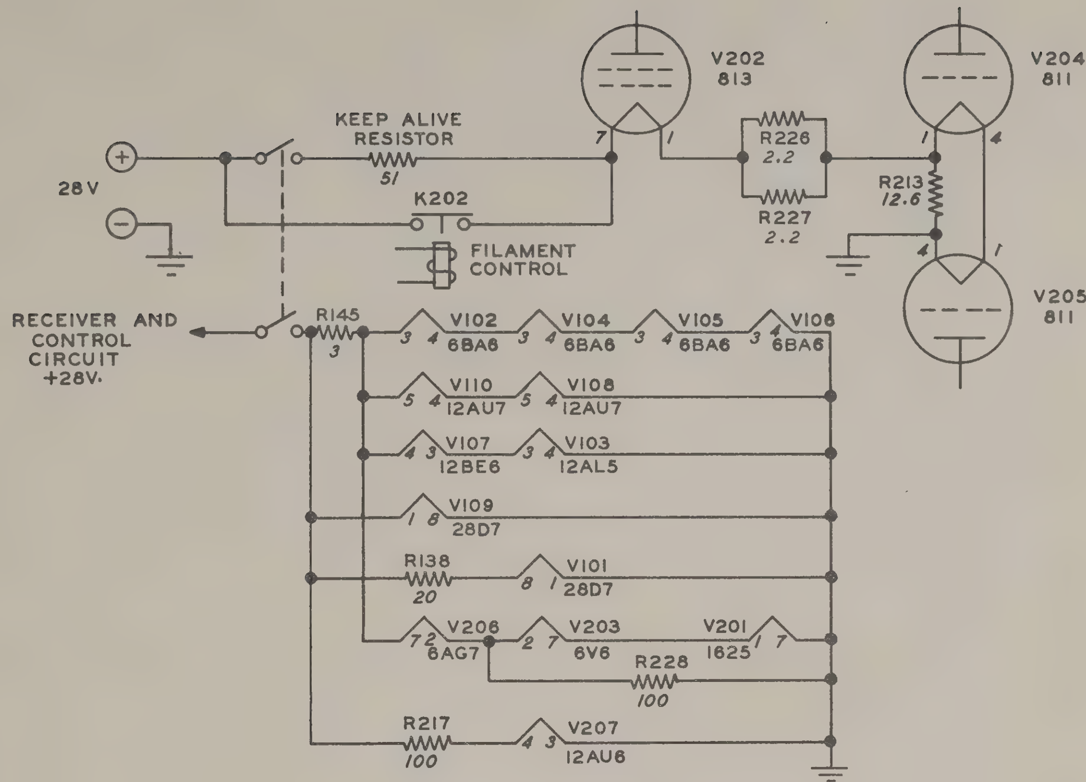


Figure 2-6 Filament Circuit Schematic

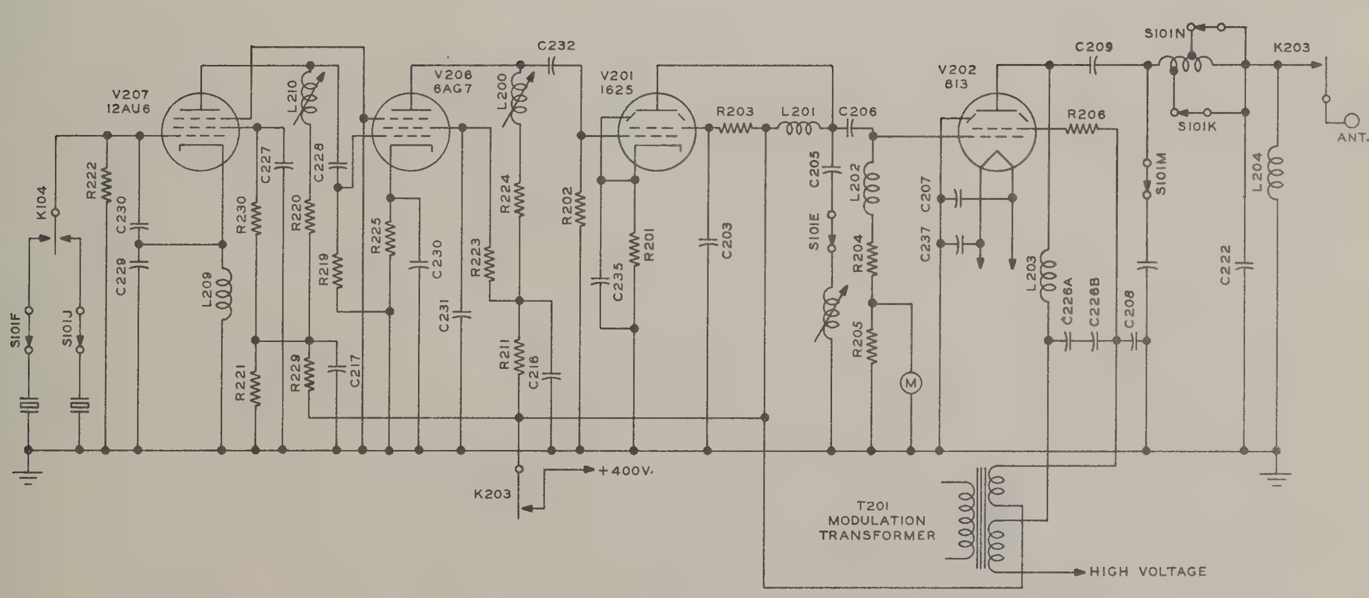


Figure 2-7 Transmitter Section Schematic

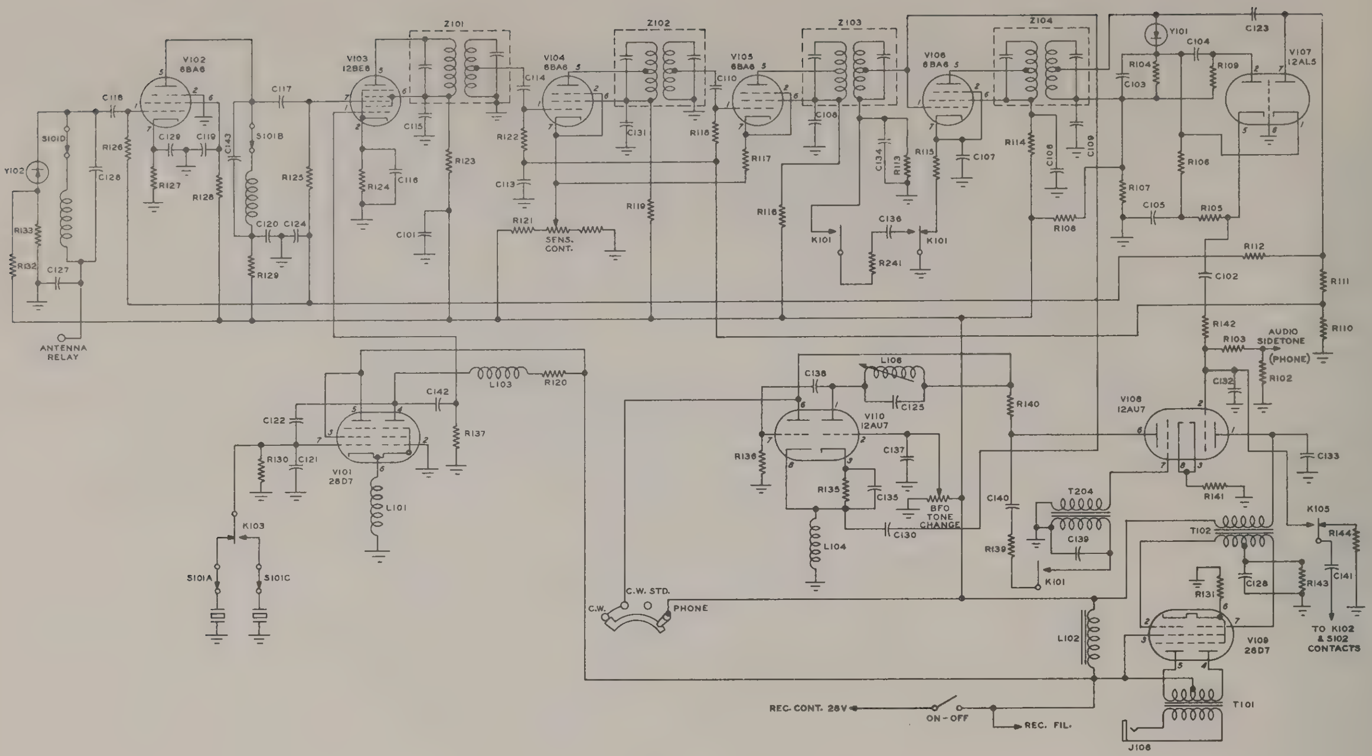


Figure 2-8 Receiver Section Schematic

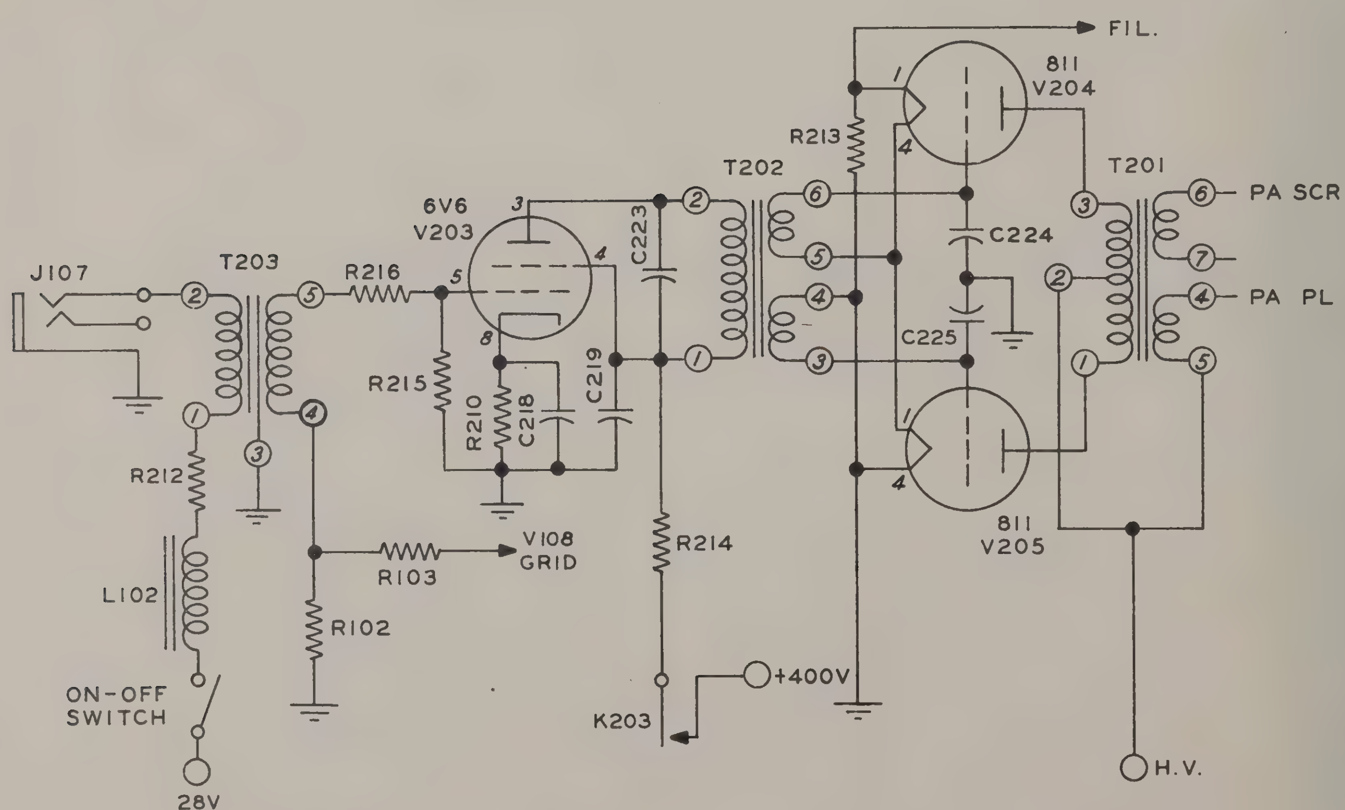


Figure 2-9 Audio Amplifier Schematic

coupled to the grid of V-102 by C-118. AVC voltage is shunt-fed to the control grid through R-126.

The output circuit of the r-f amplifier consists of distributed circuit capacitance and one of ten adjustable slug-tuned coils selected by S-101B. This circuit is coupled to the signal grid of the mixer by C-117.

(3) MIXER. - V-103 type 12BE6, is employed in the mixer circuit to combine the oscillator and signal frequencies. Oscillator r-f voltage is injected into the injection grid of the tube. The plate circuit of the mixer tube is tuned to 455 kc, the intermediate frequency. AVC voltage is shunt fed to the mixer grid through resistor R-125.

(4) HIGH FREQUENCY OSCILLATOR. - The oscillator tube, V101, type 28D7, dual pentode is crystal controlled. The circuit employed is a cathode follower oscillator circuit in which crystal is placed between grid and ground of the first section of the dual tube. The second section receives excitation from the common cathode connection. The voltage produced by the second section is capacitively coupled to the grid of the first section in correct phase relationship to sustain oscillation. No tuned coil is necessary in this circuit. Ten crystal selections on each of the two crystal-choice relay positions are available. Radio frequency voltage for injecting into the mixer tube is obtained from the plate of the oscillator tube. Second harmonic frequencies are used for injection into the mixer above 9.0 mc.

(5) INTERMEDIATE AMPLIFIER. - Three stages of intermediate frequency amplification, using 455 kc permeability tuned transformers are employed in the receiver. AVC bias is applied to the first two stages while the grid return of the third stage is grounded. The receiver is muted during transmission by opening the cathode circuit to the third i-f stage and placing a delay voltage on its grid. The cathode connections to the first and second i-f tubes (V104 and V105) are brought out to terminals 13 and 14 on connector P102 to provide connections for the external sensitivity control.

(6) DETECTOR CIRCUIT. - A 1N38 fixed crystal rectifier is employed as detector in the receiver. The rectified output voltage appears across resistor R104 and capacitor C103. Audio output voltage is coupled to the input of the noise limiter by capacitor C104. Direct current for operating the noise limiter is taken from the diode load resistor R104.

(7) NOISE LIMITER. - A series-type noiselimiter is employed. A diode tube V107, type 12AL5, is connected in series with the first audio stage input circuit in such a fashion to conduct normal audio signals from the detector output to the grid of the first tube; however, when a sharp, high amplitude noise impulse is received, it is limited in amplitude to approximately 30% modulation.

In operation, rectified carrier voltage from diode load resistor R104 is applied to the elements of the limiter section of V107 (terminals number 2 and 5 of X107). The plate of the limiter tube is positive and the cathode is negative. Capacitor C105 and resistor R105 and R106 form a filter circuit which prevents the audio from the diode load resistor R104 reaching the cathode of the limiter tube, therefore, the cathode is held at a steady dc potential. Audio voltage reaches the plate of the limiter tube through capacitor C104 and modulates the current flowing through the limiter tube. The modulated current flow through the limiter tube develops a voltage across resistor R105. The voltage is then coupled to the first audio stage by capacitor C102. The audio impulses applied to the limiter plate are negative in character and since the plate is positive, a negative impulse from the audio (of high enough magnitude to reverse the polarity on the limiter plate) will stop the limiter tube conducting thereby interrupting the audio signal through the limiter.

(8) AUTOMATIC VOLUME CONTROL. - One section of the duo-diode tube V107, type 12AL5 is employed in a delayed AVC circuit (terminals number 1 and 7 on socket X107). The plate of the AVC tube is coupled to the output terminal on the last i-f transformer (terminal number 5) by capacitor C123. A fixed positive voltage obtained from the primary power supply, is placed on the cathode of the AVC tube through a voltage divider consisting of R107 and R108 and through series resistors R104, R105 and R106. This positive voltage on the cathode, biases the diode so the tube will not rectify the i-f carrier applied to the plate until the i-f carrier voltage is of great enough amplitude to overcome the fixed bias voltage. In this manner, the AVC controlled tubes are maintained at the most sensitive condition on weak signals. As soon as the i-f carrier signal becomes great enough in amplitude to overcome the fixed bias, the AVC tube rectifies a portion of the carrier voltage. The d-c voltage thus developed across load resistors R110 and R111 is applied to the grids of the r-f amplifier and the first two i-f amplifier tubes. The last i-f stage is equipped with a delay circuit to prevent key clicks from appearing in the receiver output on CW. The delay voltage is taken from C136 when the microphone relay is closed, and thus blocks the grid of the last i-f tube momentarily.

(9) AUDIO AMPLIFIER. - Refer to figure 2-8. One-half of V-108, type 12AU7 dual triode tube is employed as an audio driver in the receiver. The 12AU7 tube receives grid excitation from the noise limiter through capacitor C102. The driver tube is transformer coupled to the grids of the audio output tube by transformer T102.

V-109, type 28D7, dual pentode operating in push-pull Class A service is employed in the audio output stage in the receiver. The input transformer, T102, has a center tapped secondary, the outside terminals of which are connected to the control grids of the Type 28D7 tube. The center tap of the input transformer secondary winding is connected to ground through a 220,000 ohm resistor which furnishes bias to the grids of the 28D7 tube. The plates of the type 28D7 tube are connected to the output transformer T101. Plate and filament

voltage for the audio output tube is obtained from the primary power source. In order to disable the receiver during band-change an R-C delay circuit consisting of C141, R144 and relay K105 is incorporated in the grid return circuit of the last audio tube. During band change, relay K405 operates and connects C141 to the center tap of T102. The charging current develops a blocking bias voltage across R143 and disables V109. After the band change operation, C141 is discharged through R144.

(10) BEAT FREQUENCY OSCILLATOR. - In order to receive CW signals with the Model 18S-4 Equipment, a beat frequency oscillator has been provided. The oscillator employs V110, type 12AU7, dual triode, one section of which is used in a resonant circuit tuned to a nominal frequency of 455 kc. The second section of this tube is used to provide feedbank to the grid of the first section and to tune the oscillator tank circuit over a limited range. This tuning effect is accomplished by the phase relation of the plate current components in the second section to the grid voltage in the first section caused by capacitor C138. This reactance characteristic of the circuit is changed by variation of grid bias. A potentiometer to be located in the remote control unit is used to vary the value of the fixed bias applied to the BFO grid. The BFO is turned on by operation of the FUNCTION SWITCH to be located in the remote control unit.

(d) TRANSMITTER SIDETONE. - When the function selector switch is in the PHONE position, voice transmissions from the transmitter are monitored. Audio signals from the microphone transformer T-203 are coupled into the receiver audio amplifier section.

(e) SIDETONE OSCILLATOR. - One-half of V108 is connected in an audio oscillator circuit providing a CW sidetone signal. The sidetone oscillator is turned on when the FUNCTION switch is set to CW position and is keyed by contacts 7 and 8 of relay K-101.

(f) 18S-4 CRYSTAL DATA.

(1) GENERAL. - For best results, it is recommended that the frequency of the crystals employed in the receiver be less than 10 mc and in the transmitter be less than 6 mc. When operation is desired on a higher frequency, the second harmonic of a lower frequency crystal should be used. Refer to figures 8-13 and 8-14 for specifications of crystals and holders for use in this equipment.

(2) RECEIVER. - For reception of signals up to 9 mc, it is recommended that the frequency of the crystals be 455 kc higher in frequency than the signal frequency. Thus the crystal frequency is equal to the signal frequency plus 455.

For reception of signals above approximately 9000 kc, it is recommended that the second harmonic of the crystal frequency be 455 kc lower in frequency than the signal frequency. Thus the crystal frequency is equal to the

signal frequency minus 455 kc divided by 2.

(3) TRANSMITTER. - For transmission of signals up to approximately 6 mc the fundamental frequency of the crystal may be used; however, for transmission of signals above 6 mc it is recommended that the second harmonic of a lower frequency crystal be used, that is, the crystal frequency would be equal to the output frequency divided by 2.

SECTION 3

INSTALLATION AND INITIAL ADJUSTMENTS

1. INSTALLATION.

a. PRELIMINARY.

(1) UNPACKING. Refer to figure 1-1. - The Model 18S-4 Transmitting-Receiving equipment is packed in heavy cartons. Refer to the "LIST OF MAJOR UNITS" in Section 1 of this instruction book and to the packing slip for a list of all the units supplied. Remove all of the packing material and lift the units out carefully. Search all of the packing material for small packages. Inspect each unit for loose screws and bolts. Be certain all controls such as switches, dials, etc., work properly. All claims for damage should be filed promptly with the transportation company. If a claim for damage is to be filed, the original packing case and material must be preserved.

Remove the transmitter-receiver cabinet by turning the two Dzus fasteners in the rear of the unit a portion of a turn counterclockwise and sliding the unit forward. Place crystals in the proper sockets and replace the cabinet.

(2) BENCH TEST. - If a number of installations are being made at one location, it is desirable to make up a test bench so that each equipment may be checked before being installed in the aircraft. Considerable time and labor may be saved if all the units are checked and operating properly before being installed.

(a) POWER SOURCE. - This equipment operates on a nominal voltage of 28 volts dc, at approximately 38 amperes. The dynamotor starting surge is quite heavy so good connections and large conductors should be used. Two number 10 AWG wires should be adequate for the primary power conductors.

(b) INSTRUMENTS, TOLLS, AND EQUIPMENT REQUIRED.

1. 28 volt dc source.

2. Mating connectors to rear of 18S-4.

3. Wires for connecting power source.

4. Headphones (approx. 500 ohms).

5. Dummy antenna - 52 ohm non-inductive.

6. 0-5 amp r-f meter, thermocouple type.

7. Modulation checking device such as an oscilloscope.

8. Audio signal generator capable of a variable output up to 2.5 volts RMS.

9. Interconnecting cables.

10. Dummy microphone.

11. R-F Signal Generator.

12. Audio Output meter (Rectifier type AC meter).

13. Remote control board containing all controls necessary for operation.

(c) TEST PROCEDURE. - The following test procedure will reveal any damage that will affect the operation of the equipment.

1. TRANSMITTER.

a. Make interconnections between power source, transmitter-receiver unit, and control panel and connect the control cable to the antenna matching network. (Do not connect the coaxial line to the network.) See figures 3-1 and 3-2.

b. Connect the dummy microphone to the MIC jack.

c. Connect the 50 ohm non-inductive dummy load in series with the 0-5 amp meter to the coaxial line connector.

d. Place the function selector switch on the control panel in the PHONE position.

e. Place the ON-OFF switch on the control panel in the ON position and the TEST switch in the antenna matching network unit in the ON position.

f. Rotate the CHANNEL SELECTOR switch to the position corresponding to the desired frequency.

The band change mechanism should operate and set up on the chosen channel. Check by noting rotor position of front switch wafer S101M.

g. Operate the CHANNEL SELECTOR switch to all 10 positions to see that the band change mechanism is operating correctly.

h. Place the meter selector switch in the BATTERY position and observe the battery voltage reading. Meter reading should be in red area.

i. Place the meter selector switch in the PA GRID position.

j. Press the push-to-talk button momentarily and observe the grid current reading of the power amplifier. The meter reading should be in the red area or above. If reading is low, recheck BATTERY voltage, with push-to-talk button depressed.

k. Place the meter selector switch in the PA PLATE position and press

the push-to-talk button and observe the power amplifier plate current reading. The power amplifier plate current should read between 4.5 and 5.5 on the meter scale. (Maximum of "6".)

The power amplifier should be in resonance at any setting of the band switch; however, if the power amplifier is not is resonance, check for faulty connections or loose tuning mechanisms. If everything is normal, the r-f current to the 52 ohm load should be approximately 1.5 amp.

l. Check the operation as outlined above on all operating frequencies. (The PA current meter in the antenna matching network should read identically to the meter in the transmitter-receiver unit while these checks are being made.

m. Connect the audio oscillator to the dummy microphone and connect the oscilloscope to the 52 ohm dummy r-f load.

n. Press the push-to-talk button and advance the gain control on the audio oscillator until 100% modulation is obtained. Measure the audio input voltage to the MIC jack. This should be 0.8 to 1.2 volts rms. The plate current meter reading should be near 9 on the PA PLATE meter scale.

o. If a distortion meter is available, the percentage distortion and noise level may be measured.

2. RECEIVER.

a. Connect the low impedance output (approx. 50 ohms) of the r-f signal generator to the coaxial transmission line connector.

b. Remove the push-to-talk switch connection from the MIC jack.

c. Connect a 500 ohm resistor across an output meter and plug into the PHONE jack on the control panel.

d. Place the ON-OFF switch in the ON position.

e. Place the CHANNEL SELECTOR switch in the proper position for the frequency chosen.

f. Tune the signal generator to the proper frequency and modulate the signal from the signal generator 30 per cent with 400 cps.

g. Advance the gain control on the signal generator until an audio output of 50 milliwatts is obtained. The r-f input to the receiver from the signal generator should be less than 10 microvolts.

h. Check the sensitivity of the receiver in like fashion for all operating frequencies. (For sensitivity check below AVC threshold, apply 4 μv

input and expect approximately 40 mw output.)

i. Advance the r-f gain control on the signal generator until at least 0.5 volt is applied to the receiver input terminal. The output should remain constant within 2 db of the original setting for threshold AVC.

j. The sensitivity and AVC checks given above should be sufficient for the bench test, however, a band width check may be given.

k. Check the audio output from PHONE jack.

3. 180K-3 ANTENNA MATCHING NETWORK UNIT. - Since the antenna matching network is not pretuned at the factory, the only bench test possible is a visual inspection of the r-f components and an operation check of the mechanical tuning mechanism. The mechanical tuning mechanism may be checked at the same time that the transmitter-receiver band change mechanism is checked. Instruction for connecting and adjusting the matching network can be found in the INITIAL ADJUSTMENT portion of this section.

(d) MINIMUM ACCEPTABLE PERFORMANCE. - The following tables give typical performance under test bench conditions. It should be possible to obtain performance comparable to these figures. If the performance differs widely from the following figures, look for damaged equipment or incorrect test procedure.

1. INPUT CURRENT AT 28 V BATTERY VOLTAGE.

CONDITIONS	INPUT CURRENT
PA loaded to 5 on meter, unmodulated	27 amps
Stand by, modulators and PA fils off (Receiving)	2.5 amps
Stand by, modulators and PA fils energized by "Keep Alive"	5 amps

2. RF OUTPUT INTO DUMMY LOAD.

FREQ.	LOAD (None reactive)	OUTPUT CURRENT	PA PLATE I
2.0 to 18.5 mc	50 ohms	1.5	150 ma

3. TRANSMITTER AUDIO DATA.

Input voltage from dummy microphone for 90% modulation = 1.0 volts rms.
Audio harmonic distortion with 90% modulation = 6% maximum.
Noise level below 100% mod. = 48 db.

4. TRANSMITTER FREQUENCY RESPONSE.

50% modulation at 800 cps.

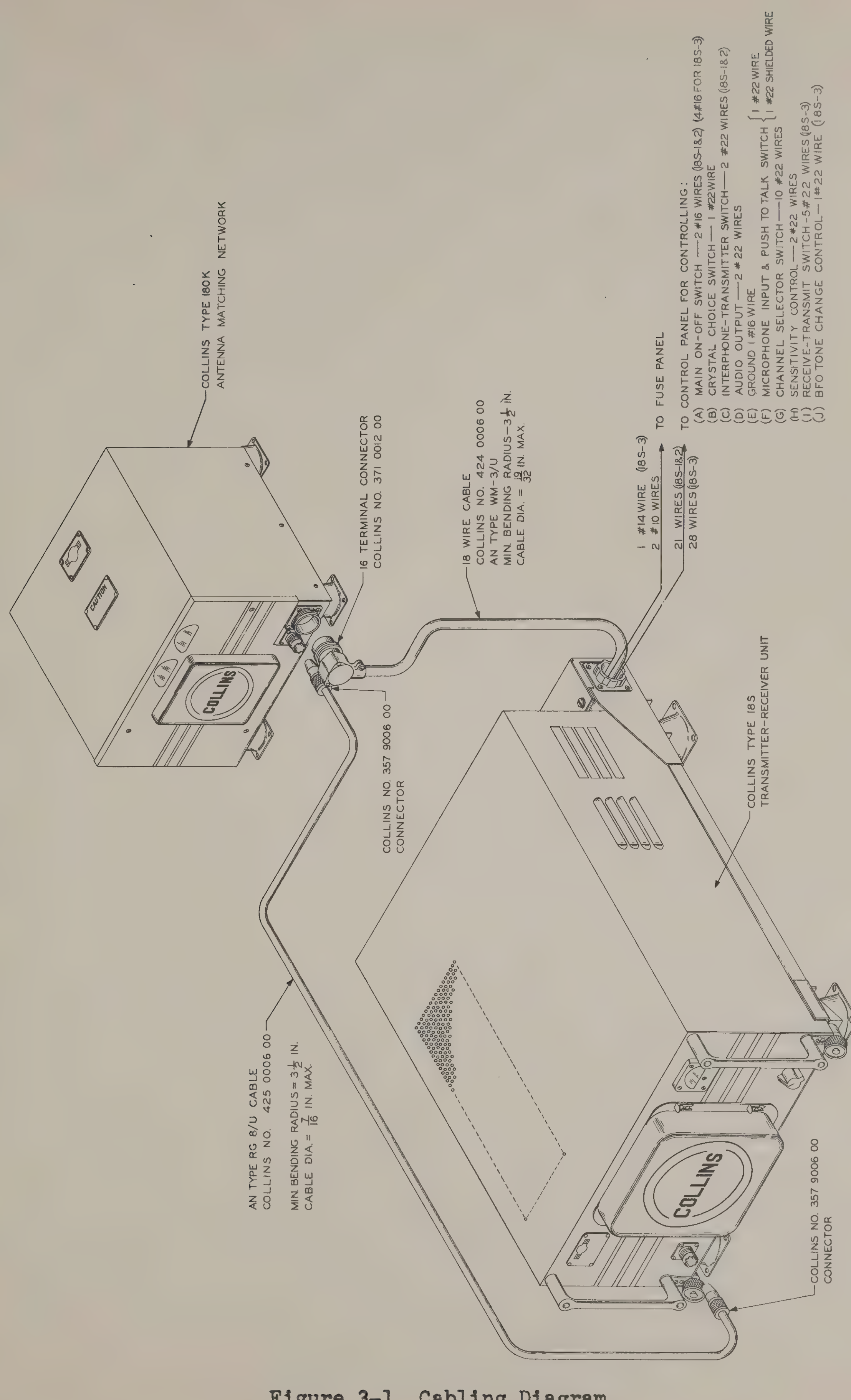


Figure 3-1 Cabling Diagram

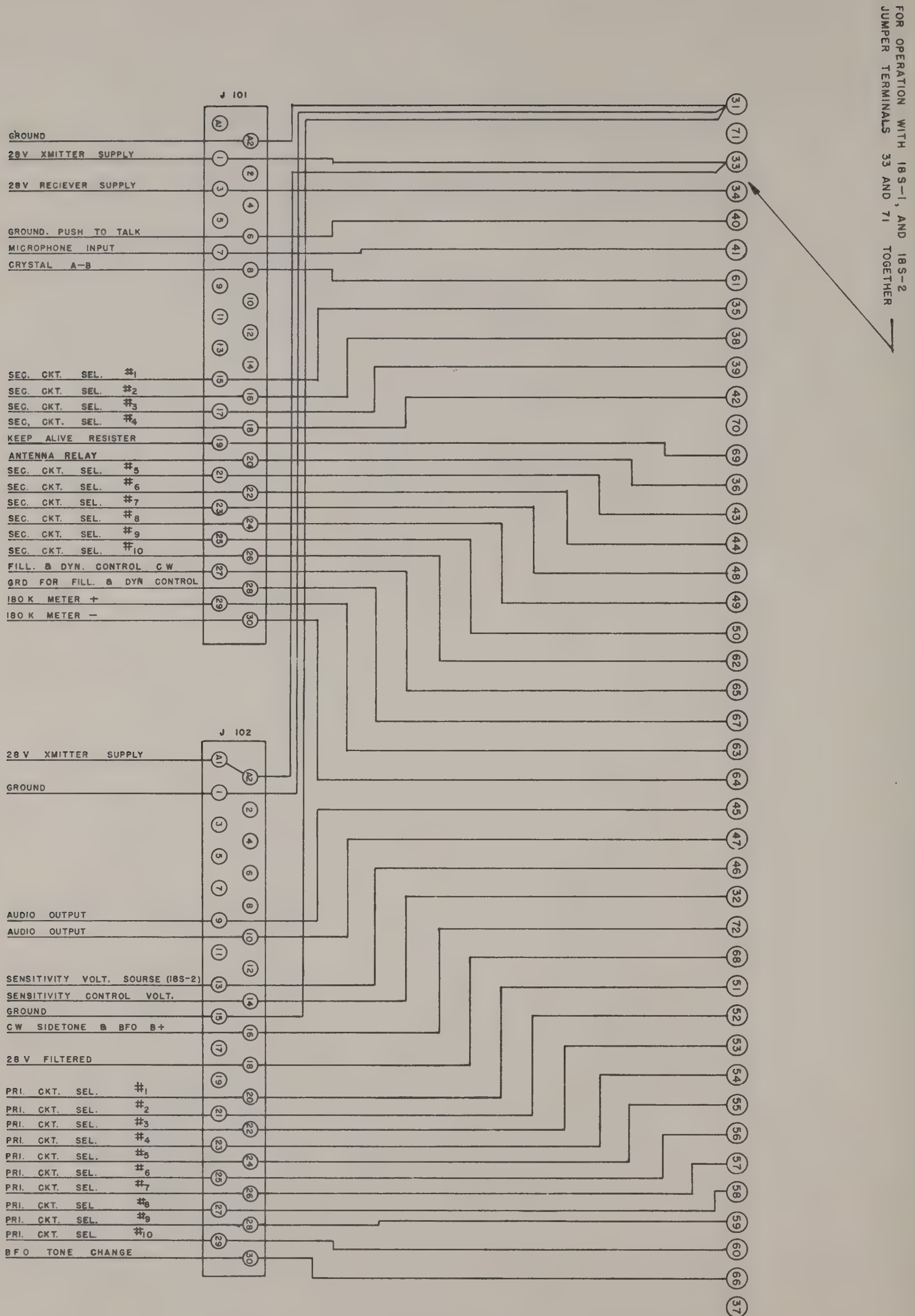


Figure 3-2 Shockmount Wiring Schematic

cps	200	300	600	800	1000	2000	3000	4000	6000	8000	10000
db	-17	-5	-.4	0	-.2	-3	-7	-9	-13	-15	-17

5. RECEIVER SENSITIVITY (NOMINAL).

Input = 5 microvolts mod. 30%.
Output = 50 milliwatts into 500 ohm load.

b. INSTALLATION PROCEDURE.

(1) MOUNTING POSITIONS.

(a) GENERAL. - This equipment is intended to be remotely controlled, therefore, it is possible to mount the transmitter-receiver unit in some remote position which will not be detrimental to the normal operation of the aircraft. The antenna matching network should be located in a position more accessible since minor tuning adjustments can be made at this unit when necessary.

(b) TRANSMITTER RECEIVER UNIT. - This unit is a standard 1-1/2 ATR (JAN-C172-C1-D) size. The overall dimensions including the shockmount base are approximately 24-9/16" long x 9-1/2" high x 16-11/16" wide. The exact mounting dimensions may be obtained from figure 8-8. The mounting base is attached to the aircraft by four mounting feet each of which are provided with four 3/16" holes for mounting bolts. It will be necessary to have at least one inch clearance all around the unit for free movement of the shockmount. Free circulation of air for ventilation purposes requires two inches clearance on the left and right sides. Approximately 12 inches clearance in front of the unit is desirable for removal of the unit from the shockmount.

The transmitter-receiver unit may be mounted on a rack especially constructed for the communication equipment or in an out-of-the-way place since once the equipment is operating satisfactorily, no further adjustments or attention will be necessary until a regular maintenance check-up is made. Any corrections in tuning required because of change in operating conditions are made at the 180K-3 Antenna Matching Network Unit.

(c) 180K-3 ANTENNA MATCHING NETWORK. - The antenna matching unit should be mounted as near the antenna feedthru bowl as possible. The unit should be mounted in a location which is more accessible than the transmitter-receiver unit since final adjustment and corrections in tuning are made at this unit. The antenna matching unit is equipped on the bottom with four shockmount feet each of which are drilled with four 9/64" mounting holes. The shockmount feet are provided with grounding straps to insure a good ground for the network circuit.

The overall dimensions for the network unit including shockmount are: 10-7/8" long x 8-13/32" high x 11-3/8" wide. A clearance of one-half inch on all sides is required for free movement of the unit on the shockmount. At least

1-3/4" clearance is required around the antenna lead-in and antenna connector for voltage breakdown. A minimum of six inches in front of the unit is necessary for removal of the cover plate, however, adequate clearance must be allowed for adjusting the tuning controls. Refer to figure 8-9 for complete outline and mounting dimensions of the antenna matching network unit.

(d) REMOTE CONTROL UNIT. - The following parts can be obtained from Collins Radio Company and assembled to control the 18S-4 equipment. It includes suitable parts to fit each symbol shown in the Remote Control section on the complete schematic, figure 8-10.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
	Function selector	SWITCH: Band change, 6 circ 3 pos, non-shorting	259 0275 00
	ON-OFF	SWITCH: Toggle, DPDT, 1 amp 250 v, 3 amp 125 v	266 0002 00
	Channel selector	SWITCH: Wafer, 20 pos.	269 1098 00
	Channel selector	FRAME: 20 position	269 1101 00
	Microphone jack	JACK: Phone, midget, 3 circ	358 1050 00
	Key jack	JACK: Phone, midget, 3 circ	358 1050 00
	Headphone jack	JACK: Phone, midget, for 2 cond plug	358 1080 00
	Headphone jack	JACK: Phone, midget, for 2 cond plug	358 1080 00
	Sensitivity series	RESISTOR: 270 ohm ±10%, 1/2 w	745 1062 00
	BFO tone series	RESISTOR: 6800 ohm ±20%, 1/2 w	745 1122 00
	BFO tone control	RESISTOR: 1000 ohm ±20%, 1/2 w	376 5516 00
	Sensitivity control*	RESISTOR: 5,000 ohm ±20%, 1/2 w	376 4251 00
	Volume control*	RESISTOR: 2500 ohm ±20%, 1/2 w	376 4250 00
	Transient filter	CAPACITOR: 1 mfd. 200 V	931 0174 00

*Alternate, volume and sensitivity control combined, 2000 & 5000 ohm 376 9001 00
*Alternate, volume and sensitivity control combined, coaxial shafts 2000 and 5000 ohm 376 2146 00

(2) POWER AND CONTROL CONNECTIONS.

(a) GENERAL. - All power and control connections can be made up using multi-conductor cables. Adequate lengths of cable are available in bulk so that

the cables can be made up to correct length for each installation. It is suggested that the technician making up the cables employ a pair of wire insulation strippers for removing the insulation from the ends of the wires. It will also be necessary to have a soldering iron, solder, a pair of side cutters, a pair of long noise pliers, a screwdriver and a 5/16" socket wrench in making up the cables. Use only the highest grade of rosin core solder. Use soldering lugs to make connections to the #6 screws on the shockmount terminal strip. Have the ends of the wires tinned before making the connection to the lugs and apply the heat only long enough to completely melt the solder. Varnished insulating tubing or equivalent may be skipped over the connections to the lugs to help prevent short circuits. All cables should be cut long enough to permit free movement of the shockmounts.

(b) POWER CONNECTIONS. Refer to figure 3-1. - Two number 10 AWG wires will be sufficient for primary power connections. These wires should be as short and direct as possible. Good connections are important.

(c) KEEP ALIVE RESISTOR. - For services requiring fast break-in operation, the 18S has been designed to include a connection in the filament circuit which will allow the 813 and 811 tubes to remain partially heated. This is done with a keep alive resistor which is mounted in a ventilated enclosure on top of the shockmount rear connector.

(d) CONTROL CABLE CONNECTIONS. - A cable containing at least 28 wires is required for connections to the control panel. Wire sizes and connections are given below:

1. Main ON-OFF switch - 4 #16 wires.

2. Crystal choice switch - 1 #22 wire.

3. 180K interlock switch - 1 #22 wire (#37 on shockmount).

4. Audio Output - 2 #22 wires.

5. Sensitivity control - 2 #22 wires.

6. Microphone input and push-to-talk switch or key 1 #22 wire, 1 #22 shielded wire.

7. Channel selector switch - 10 #22 wires.

8. BFO tone change - 1 #22 wire.

9. Dynamotor operation for cw - 1 #22 wire.

10. Ground for cw operation - 1 #22 wire.

11. Ground (-28 v) - 1 #16 wire.

12. BFO and sidetone plate - 1 #22 wire.

13. +28 volts for BFO and sidetone source - 1 #22 wire.

The #22 shielded wire is to be used for the microphone lead. Refer to figure 8-10 for connections to the remote control box.

All wires from the control box terminate in the terminal board at the rear of the shockmount. Refer to figure 8-10 for the shockmount connections.

(e) 180K-3 ANTENNA MATCHING NETWORK CONNECTIONS. - Two sets of connections from the transmitter-receiver unit are necessary. One set consists of the power and control connections while the other consists of the 52 ohm transmission line connection.

The power and control cable employs 16 wires and a 16 terminal connector plug. The Collins type 424 0006 00, 18 conductor cable, may be used with a Collins type 371 0012 00, 16 terminal connector plug. This cable consists of 2 #16 wires and 16 #22 wires. The two #16 wires should be connected to pins number 13 and 15 in the connector plug (power terminals). The cable can be made up as follows: Cut the cable to length, then on the plug end cut the outer cotton braid back from the end to a distance of 1-3/8". The copper shield and the inner braid should be cut back 1" from the end. The insulation should be stripped back 1/4" and the wire tinned. Refer to the schematic diagrams for the cable connections. The minimum bending radius of this cable is 3-1/2 inches.

The coaxial transmission line employs AN type RG 8/U cable Collins part number 425 0006 00 with a Collins type 357 9006 00 connector on each end. Good connections are very important. The minimum bending radius of this cable is 3-1/2 inches.

(f) ANTENNA CONNECTION. - The antenna terminates in a female connector which snaps on the male connector on the rear of the antenna matching network unit. The connection from the antenna matching network unit to the aircraft antenna feedthru should be made with a piece of flexible copper braid which should be only long enough to allow free movement of the antenna matching network on the shockmounts. There should be at least 1-3/4" clearance on all sides of the lead-in wire. A suggested aircraft skin feedthru arrangement is shown in figure 8-15.

2. INITIAL ADJUSTMENTS.

a. GENERAL. - Normally, the only adjustments necessary upon installing a Model 18S-4 equipment will be those adjustments necessary to match and load the transmitter to each individual antenna. However, in event the sequence of frequencies are to be changed or new frequencies added it will be necessary to refer to the

MAINTENANCE SECTION of this instruction book for complete instructions for aligning and adjusting the circuits affected.

b. FUNCTIONS OF CONTROLS.

(1) METER SELECTOR SWITCH. - The only control on the transmitter-receiver panel involved in the initial adjustments is the meter selector switch. The function of this switch is to connect the panel meter and the antenna matching network dc meter into the various circuits which require metering. The battery voltage, the power amplifier grid, and the power amplifier plate currents are metered. The dc meter reads in arbitrary units only.

(2) ANTENNA MATCHING NETWORK TUNING CONTROL. - The antenna matching network tuning control operates the rotor of variometer L501 to give fine adjustment of inductance in the network.

The AUTOTUNE stop rings are unlocked by turning the locking key counter-clockwise two turns. The vernier knob is automatically engaged when the AUTO-TUNE stop rings are unlocked.

(3) ANTENNA MATCHING NETWORK TEST SWITCH. - To facilitate making installation adjustments, TEST switch S-502 is provided by means of which the associated transmitter can be turned on and off. This switch is in series with the power control circuit so that if a short-circuited microphone plug is inserted in the microphone jack of the transmitter or control box, the application of transmitter power is controlled by the TEST switch. When tuning adjustments are completed, the TEST switch must be left in the ON position; a special bracket on the cover of the Type 180K-3 equipment makes it impossible to replace the cover unless the switch is in the ON position.

(4) ON-OFF SWITCH. - The ON-OFF switch is part of the remote control and is usually mounted near the pilot or the communications officer of the aircraft. The ON-OFF switch controls all of the power circuits within the Model 18S-4 Transmitter-Receiver unit. All filaments except those of the 811's and 813 are energized upon placing the ON-OFF switch in the ON position. (The 811's and 813 filaments, also, are partially energized if the keep-alive resistor is used.)

(5) FUNCTION SELECTOR. - After the ON-OFF switch has been operated to the ON position, the interphone apparatus may be used while the Function Selector switch is in the STD-BY position. The transmitter relays will not operate while this switch is in the STD-BY position, however, the microphone and receiver audio circuits are energized and operative.

When the Function Selector switch is placed in the PHONE position, it is possible to operate the control relays in the transmitter-receiver power circuits by pressing the push-to-talk button on the microphone. When this switch is in the CW position, the dynamotor relays closes immediately and the microphone and antenna relays operate when the key is pressed. The Function Selector switch is also a part of the remote control unit furnished by the customer.

(6) CHANNEL SELECTOR SWITCH. - Also a part of the remote control unit is the CHANNEL SELECTOR switch. This switch is a 20 position tap switch.

(7) SENSITIVITY CONTROL. - The SENSITIVITY control is to be located in the remote control unit and gives about 47 db attenuation.

(8) BFO TONE. - This control, to be located on the remote control unit, is used to vary the pitch of the received signal during CW operation.

c. ENERGIZING THE EQUIPMENT. - After all interconnections between units have been made and the antenna and primary power is connected, the equipment may be energized as follows:

(1) Place the meter selector switch in the BATTERY position.

(2) Place the control panel ON-OFF switch in ON position. Ready the battery voltage.

(3) Place the meter selector switch in the PA grid position.

(4) Rotate the CHANNEL SELECTOR switch to the desired frequency and allow the band change equipment to operate.

(5) Momentarily press the push-to-talk button and read the grid current. There must be an indication of grid current before the power amplifier can be loaded.

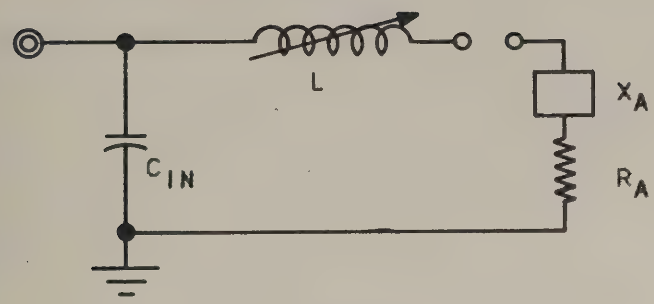
d. TUNING ADJUSTMENTS.

(1) GENERAL. - Since the transmitter-receiver unit has been tuned at the factory for the specified frequencies, it will be necessary to match and load the final amplifier to the antenna with the 180K Antenna Unit at this time.

(2) 180K-3 THEORY OF OPERATION.

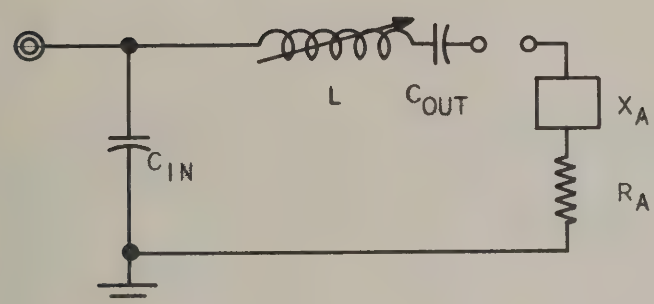
(a) GENERAL CIRCUIT THEORY. - As stated previously, the function of the Type 180K-3 Antenna Matching Network is to provide maximum transfer of energy between a 52 ohm coaxial transmission line and an aircraft antenna 45 ft. or more in length for 10 separate channels in the range 2.7 to 18.5 mc.

This impedance matching function is performed through the use of "pi" or "L" networks of inductance and capacitance. Referring to figure 8-11, the inductance is obtained by use of L-501, a continuously variable inductor (variometer),



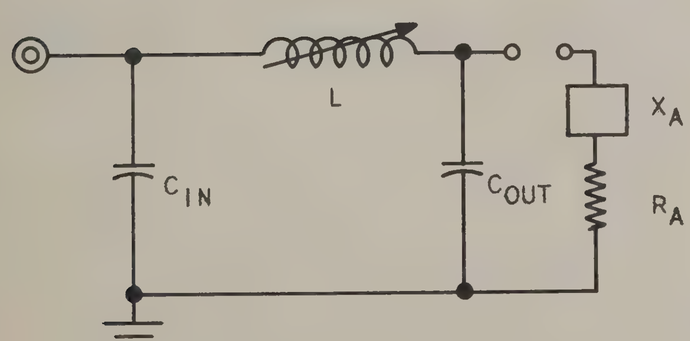
"L" NETWORK

"L" NETWORK NORMALLY USED BELOW $\lambda/4$ AND BETWEEN $\lambda/2$ AND $3/4\lambda$. X_A MUST BE NEGATIVE (CAPACITIVE) AND GREATER THAN MINIMUM X_L. R_A MUST BE LESS THAN 40 OHMS.



"L" NETWORK WITH SERIES CAPACITOR

"L" NETWORK WITH SERIES CAPACITOR USED AT OR NEAR $\lambda/4$ AND $3/4\lambda$. X_A POSITIVE OR NEGATIVE LESS THAN MINIMUM X_L. R_A MUST BE LESS THAN 40 OHMS.



"PI" NETWORK

"PI" NETWORK USED AT OR NEAR $\lambda/2$ AND λ. R_A GREATER THAN 30 OR 40 OHMS. X_A POSITIVE OR NEGATIVE ANY MAGNITUDE.

Figure 3-3 Antenna Matching Network Circuits

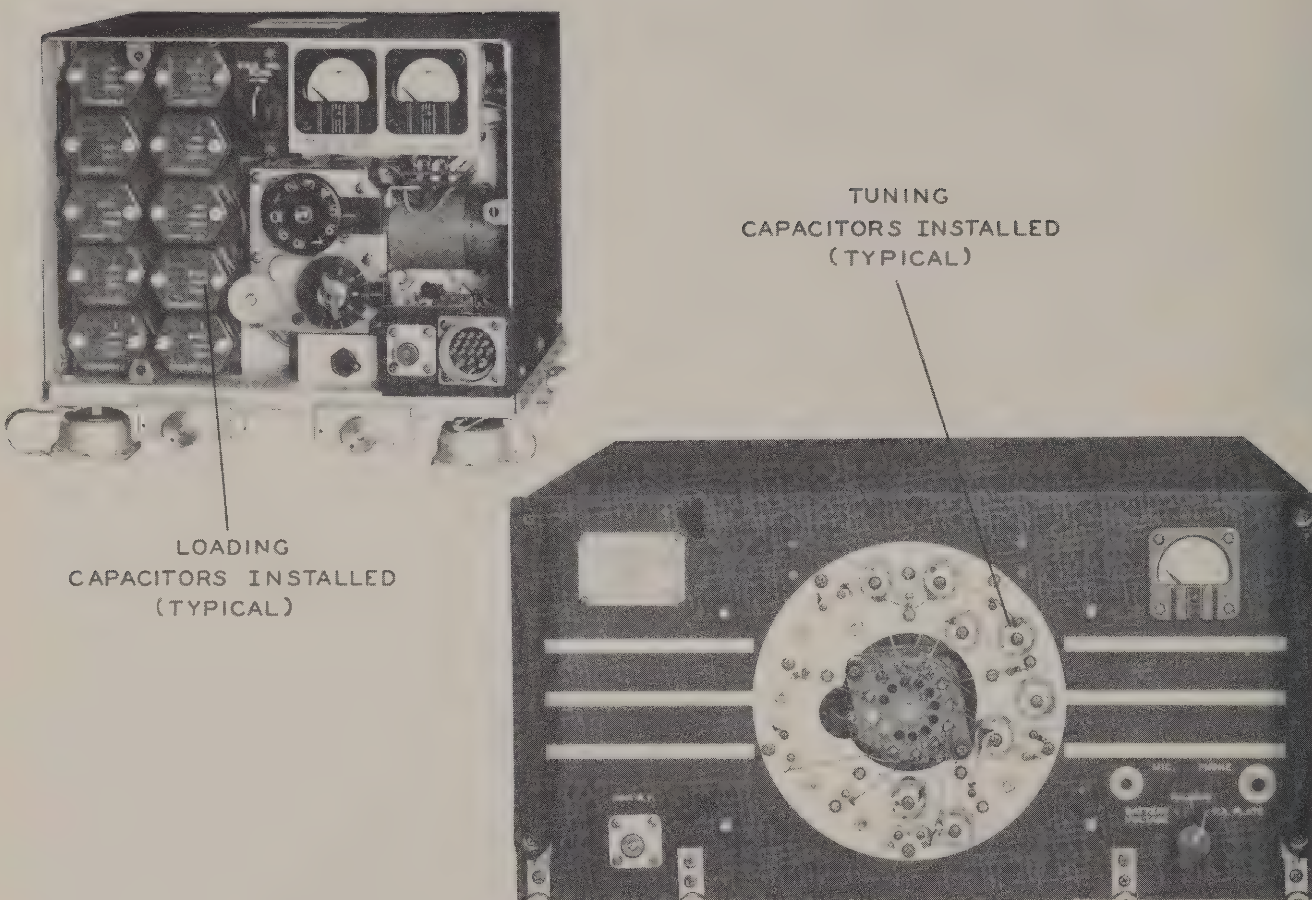


FIGURE 3-4 LOCATION OF TUNING AND LOADING CAPACITORS

used alone, connected in series with L-503, a tapped coil, or in parallel L-502, shunting coil. The capacitors used are fixed capacitors chosen to meet the requirements of the particular installation. Panels for mounting these capacitors are provided. The type of network, inductor connections and values of input and output capacitors must be determined for each frequency channel used and depend on the characteristics of the aircraft antenna and the channel frequency.

A five-section 10 position network switch, S-501, is used to connect the circuit elements in the desired configuration for each channel. This switch and the variometer, L-501, are controlled by the Autotune mechanism to provide automatic remote channel selection in synchronism with the associated transmitter.

(b) IMPEDANCE CHARACTERISTICS OF AIRCRAFT ANTENNAS. - When used over a wide range of frequencies, a single-wire aircraft antenna exhibits a very wide range of input impedance. The impedance vs. frequency characteristic is similar to that of an open-circuited transmission line since the antenna system can be considered as a transmission line in which the antenna wire is one conductor and the structure of the airplane is the other conductor. However, because of non-uniform spacing of the elements and because of lead-in capacitance and inductance, the impedance characteristic is somewhat irregular, the half-wave resonant frequency occurring at somewhat less than twice quarter-wave frequency. Figure 3-5 is the measured impedance vs. frequency characteristic of a 46 foot antenna of a Douglas DC-3 (C-47) airplane and illustrates the characteristics typical of this type of antenna.

(c) MATCHING CIRCUITS. - To match the 52 ohm r-f transmission line to the aircraft antenna, several types of network circuits are used, the choice of circuit depending on the nature of the antenna impedance. All the networks used operate in conjunction with the antenna impedance to produce a resonant circuit which is capacitively tapped by means of the input circuit to match the transmission line to the circuit. Figure 3-3 shows the various circuits used for the purpose. If the impedance characteristic of the antenna being used is accurately known, the type of network to be used and the component values for it can be calculated to a fair degree of accuracy. If impedance data is not available, the networks can be determined experimentally. Some experimental adjustments (in addition to final setting of the variometer) are almost always necessary, especially with respect to the value of the input capacitor, because of component tolerances and because the "Q" of the variometer varies by about 25% as the inductance is varied from minimum to maximum. Furthermore, antenna impedance as measured with the airplane on the ground may vary somewhat from the impedance in flight. This effect is especially noticeable with smaller airplanes such as the Beechcraft D18S, the antenna of which overhangs the ground. Another cause of impedance change is the bowing in of the antenna wire at speeds above about 275 m.p.h. Instructions for calculation and experimental determination of the matching networks are given in paragraphs following. Instructions for installation wiring of the various networks are also given.

Referring to figure 3-3 and 8-11, the "L" network is used for frequencies below quarter-wave resonance and also for frequencies somewhat above half-wave resonance, but below three-quarter-wave resonance.

The "L" network with series capacitor is used at frequencies equal to or near quarter-wave and three-quarter wave resonance.

The "pi" network is used at frequencies at or near half-wave or full-wave resonance.

The r-f choke, L-504, is connected from the antenna to ground when the "L" network with series capacitor is used to provide a d-c path from the antenna to ground through which static charges on the antenna are discharged. When the regular "L" or "pi" networks are used, this path is provided through the transmission line and through an r-f choke in the transmitter.

(d) METERING CIRCUITS. - Standing Wave Radio Indicator. - To provide indication for the selection of network components and for the final setting of the variometer, the Type 180K-3 Antenna Matching Network is equipped with an r-f bridge network which indicates the degree of mis-match (standing wave ratio) existing at the input to the network. A modified Schering bridge circuit is used, this circuit is similar to the familiar Wheatstone resistance bridge except that one pair of bridge arms is capacitive rather than resistive. Referring to figure 8-11, the capacitive arms consist of C-518, C-519, C-520, and C-521; the resistive arms consist of R-501 through R-510 (ten 10-ohm resistors connected in parallel to form a 1 ohm resistor) and the input to the matching network. The bridge detector is an r-f voltmeter employing a crystal diode, CR-501, meter M-501 and associated components. A sensitivity control, R-512, is incorporated to prevent overloading the meter when power is first applied to the network. Final adjustments are made with the Sensitivity Control at its maximum clockwise position.

The bridge is balanced (zero meter reading) when the input impedance of the network is 52 ohms resistive; this is the condition for maximum energy transfer between the transmission line and the antenna. Meter M-501, Standing Wave Ratio Indicator, is graduated in arbitrary units; at maximum sensitivity a meter reading of 2 units corresponds to a standing wave ratio of 1.5. With proper adjustment of the antenna matching network, it is ordinarily possible to obtain a minimum reading of 2 or less with the sensitivity control at maximum.

The Plate Current Meter, M502, indicates in arbitrary units the plate current of the associated transmitter to assist in final adjustment of the Type 180K-3 equipment.

(e) MATCHING ADJUSTMENT. - A good match as indicated by the S.W.R. Indicator can usually be obtained with several values of network input capacitor. The transmitter plate current, however, will vary appreciably as the input capacitor is varied. The proper choice of input capacitor is that which produces a low S.W.R. Indicator reading, and proper transmitter plate current indication.

(3) CALCULATION OF ANTENNA MATCHING NETWORKS. - As described in paragraph 2.d.(2). 180K-3 Theory of Operation, the function of the Antenna Matching Network is to provide maximum transfer of energy between a 52 ohm transmission line and an aircraft antenna. This impedance matching function is performed by the use of "pi" or "L" networks of inductance and capacitance.

VALUES OF COMPONENTS AVAILABLE:

INPUT CAPACITOR: The input capacitor mounting panel is equipped with studs for mounting one or two mica capacitors for each channel position. A listing of capacitors of the type required ranging in capacitance from 51 to 6200 mmf is provided in Section VI.

OUTPUT CAPACITORS: The output capacitors mounting panel has provisions for mounting up to seven high voltage ceramic capacitors. A listing of capacitors of 10, 25, 50 and 67 mmf of the type required is provided in Section VI. Several of these capacitors can be connected in parallel if necessary to obtain the desired value of capacity. Note that it is possible to use the same output capacitor in more than one channel network.

INDUCTANCE: The variometer L-501 and coils L-502 and L-503 can be connected to provide four ranges of variable inductance approximately as follows:

Variometer L-501 shunted by L-502: 1.5 - 2.5 microhenry.
Variometer L-501 alone: 2.5 - 12.5 microhenries.
Variometer L-501 in series with tapped L-503: 7.5 - 17.5 microhenries
Variometer L-501 in series with all L-503: 13 - 23 microhenries.

For use on frequencies below the rated frequency of 2.7 mc, inductor L-503 can be replaced by a special tapped inductor, Collins Part No. 571 1258 30. In combination with variometer L-501, this inductor provides variable inductance up to 50 μh.

The "Q" of the inductors varies somewhat with frequency and the type of connection used; however, a value of Q = 100 is sufficiently accurate for use in making network calculations.

(a) CALCULATION PROCEDURE. - Figure 3-6 is a schematic diagram showing

the output circuit of the transmitter, the coaxial transmission line, the antenna matching network and the airplane antenna. Sections 3 and 4 constitute the antenna matching network.

Section 3.

Section 3 is the first or input element of the network and consists of the input capacitor and the inductance required to resonate it. This capacitor and inductor act as an "L" network to transform the input impedance of Section 4 (designated here as R_{ph}, the phantom or reflected resistance). This phantom resistance depends on the antenna radiation resistance, R_a, the loss resistance of the tuning inductor of Section 4, R_L, and the type of impedance transformation performed by Section 4. The loss resistance of the tuning inductor of Section 3 is neglected in these calculations since it is usually very small as compared with the other resistances in the circuit. Note that the tuning inductors of Sections 3 and 4 are not actually separate in the final circuit, but their values are added together to give the total inductance of the circuit.

In order to be transformed to 52 ohms by Section 3, R_{ph} as presented by Section 4 must always be less than 52 ohms.

The values of X_c and X_L of Section 3 are given by:

$$\frac{X_c^2}{R_{ph}} = 52 \text{ ohms} \qquad X_L = X_c = \sqrt{52\, R_{ph}} \text{ (For } R_{ph} = 10 \text{ ohms or less)}$$

$$X_c = \frac{52}{\sqrt{\frac{52}{R_{ph}} - 1}} \qquad X_L = R_{ph}\sqrt{\frac{52}{R_{ph}} - 1} \text{ (For } R_{ph} \text{ 10 to 52 ohms)}$$

Section 4.

The function of Section 4 is to transform the impedance of the antenna to a purely resistive R_{ph} of less than 52 ohms. When the antenna resistance is low compared with 52 ohms, Section 4 need only provide a reactance equal and opposite to the antenna reactance X_a. When R_a is such that the sum of it and the loss resistance of the inductor, R_L, exceeds 52 ohms, additional transformation must be performed by the use of the "pi" type network.

For purposes of calculation, four general classifications of antenna impedance have been set up as follows (refer to figure 3-5).

<u>Class 1</u>. Antennas operating below quarter-wave or three-quarter-wave resonance; in this condition R_A will be very low (1 to 5 ohms) and X_A will be negative (Capacitive) ranging from higher than 600 ohms to zero at exactly quarter-wave resonance.

Class 2. The Class 2 antenna operates as very nearly or exactly quarter-wave or three-quarter-wave resonance and exhibits low resistance (2 to 5 ohms at quarter-wave resonance; 20 to 30 ohms at three-quarter-wave resonance) and zero or low values of reactance.

Class 3. The Class 3 antenna operates between quarter-wave and half-wave or between three-quarter-wave and full-wave resonance. Resistance is moderate to high and reactance is inductive.

Class 4. The Class 4 antenna operates at or near half-wave or full-wave resonance and shows high values of reactance and resistance.

(b) CONFIGURATIONS FOR SECTION 4.

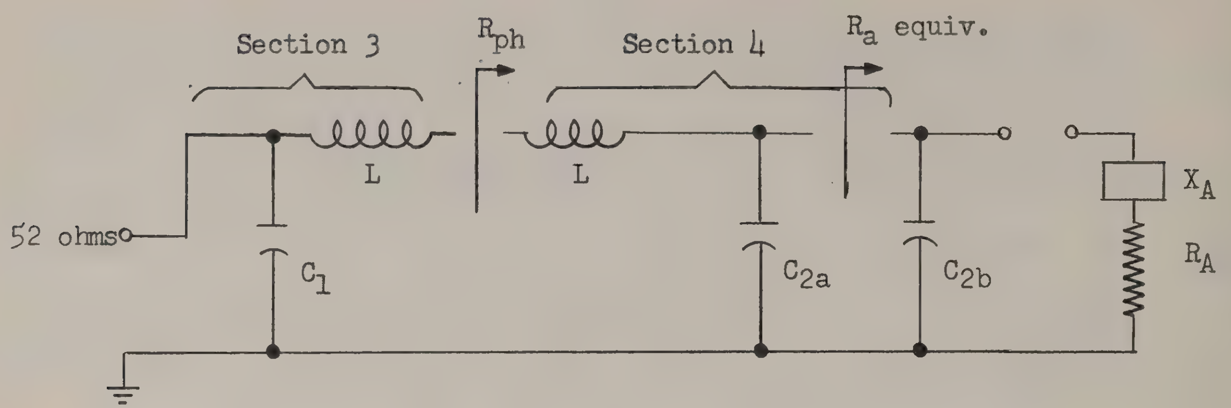
Class 1 Antenna. For the class 1 antenna, Section 4 need consist only of series inductance of reactance equal to the antenna reactance X_A. Phantom resistance R_{ph} will equal the antenna resistance R_A plus the inductor resistance R_L which can be calculated from the equation $R_L = \frac{X_L}{Q}$.

Class 2 Antenna. For the class 2 antenna, the antenna reactance will be low (or may be inductive) so that the minimum inductance available cannot resonate it. In this case a series capacitor or reactance approximately equal to minimum available inductor reactance must be used. R_{ph} in this case will equal R_A plus R_L as in the case of the class 1 antenna.

Class 3 Antenna. The class 3 antenna requires the use of a series capacitor to resonate the inductive reactance of the antenna and the minimum reactance available in the tuning inductor. This capacitor can be calculated from $X_c = X_a + X_1$. Phantom resistance will be $R_{ph} = R_A + R_L$. If R_{ph} exceeds 52 ohms, the antenna will have to be treated as a class 4 antenna. Furthermore, the voltage rating of the series capacitor must not be exceeded. This voltage can be computed from the equation $V_c = X_c I_A$; antenna current I_A can be calculated from the power expression $P = I_A{}^2 R_{ph}$, the power normally being 100 watts. The voltage across the capacitor should not exceed 1000 V as thus calculated.

Class 4 Antenna. The class 4 antenna is matched by use of a "pi" network, in which the output capacitor is connected in parallel with the antenna. Since the R_a of a class 4 antenna exceeds 52 ohms, it is necessary to transform this high impedance to R_{ph} of less than 52 ohms by means of Section 4.

The following circuit diagram illustrates the procedure followed in computing the network for the Class 4 antenna.



Note that in the above diagram, the output capacitor C_2 is divided into two parts for purposes of calculation. C_{2b} is the amount of capacitance required to resonate the antenna to a purely resistive impedance, R_a equiv. In the case of half wave resonance C_{2b} will equal zero and R_a equiv will equal R_a. At frequencies less or greater than that of half wave resonance,

$$X_{c2b} = -X_a \text{ and } R_a \text{ equiv.} = \frac{(X_a)^2}{R_a}$$

R_a equiv. is then transformed to R_{ph}' by L and C_{2a}. To this value of R_{ph}' must be added $R_L = \frac{X_L}{Q}$ to give R_{ph}. R_{ph} must be less than 52 ohms and is then transformed to 52 ohms by Section 3 as in previous cases.

L and C_2 of Section 4 must be found by trial calculation using values of C_2 which can be obtained with combinations of the capacitors available for use in this position (10, 25, 50 or 67 mmf, or combinations thereof up to 200 mmf). To the capacitance chosen should be added a value of 30 mmf, which is the value of the distributed capacitance of the circuit.

The equations to be used for calculation of L and R_{ph}' are:

$$X_L = X_{(C2 + 30)} \left(\frac{X_a}{X_a - X_{(C2 + 30)}} \right)$$

where X_a is positive (inductive) and

$$X_L = X_{(C2 + 30)} \left(\frac{X_a}{X_a + X_{(C2 + 30)}} \right)$$

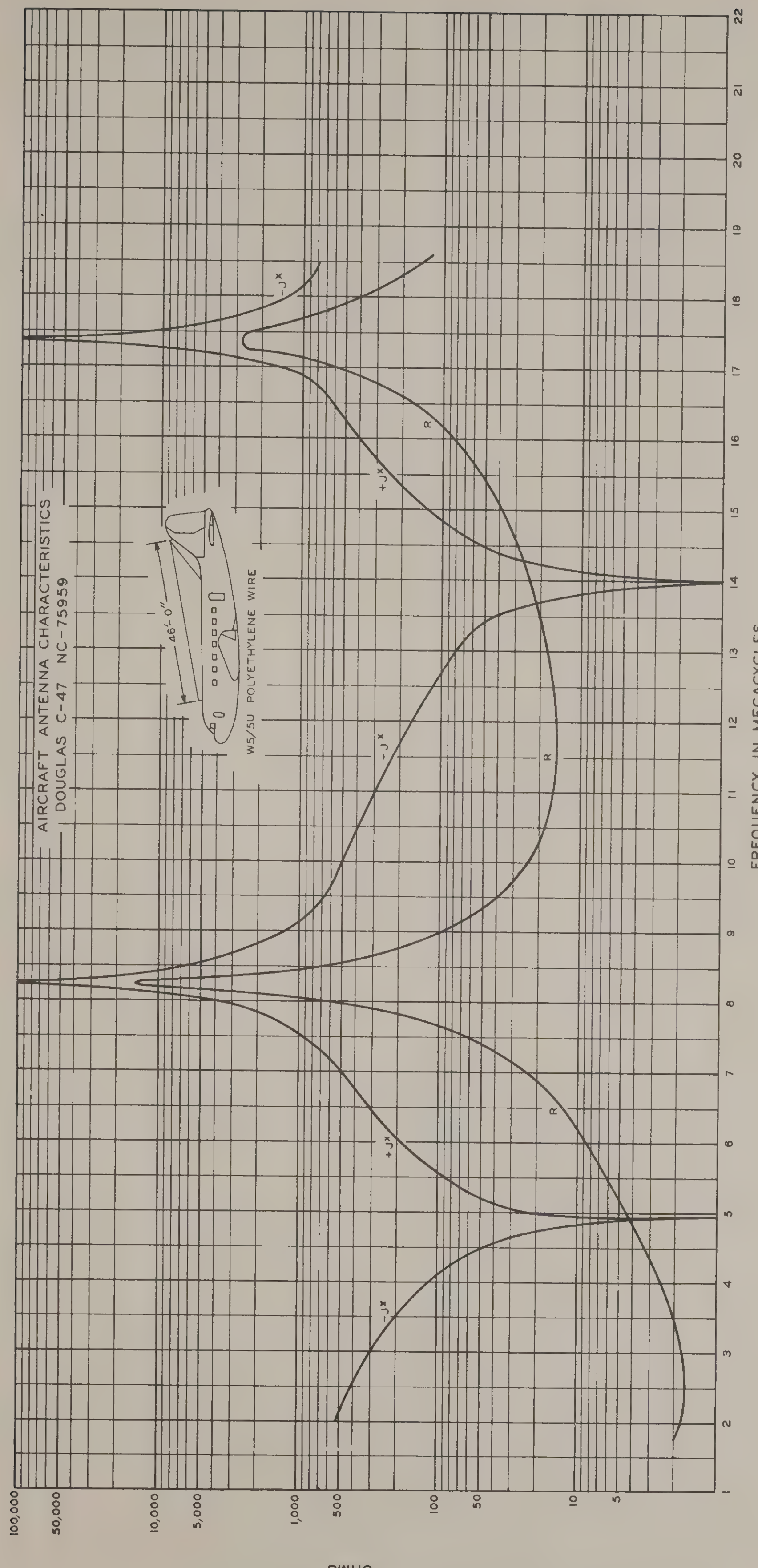


Figure 3-5 Impedance VS Frequency Characteristic of 46 ft. Antenna in DC-3

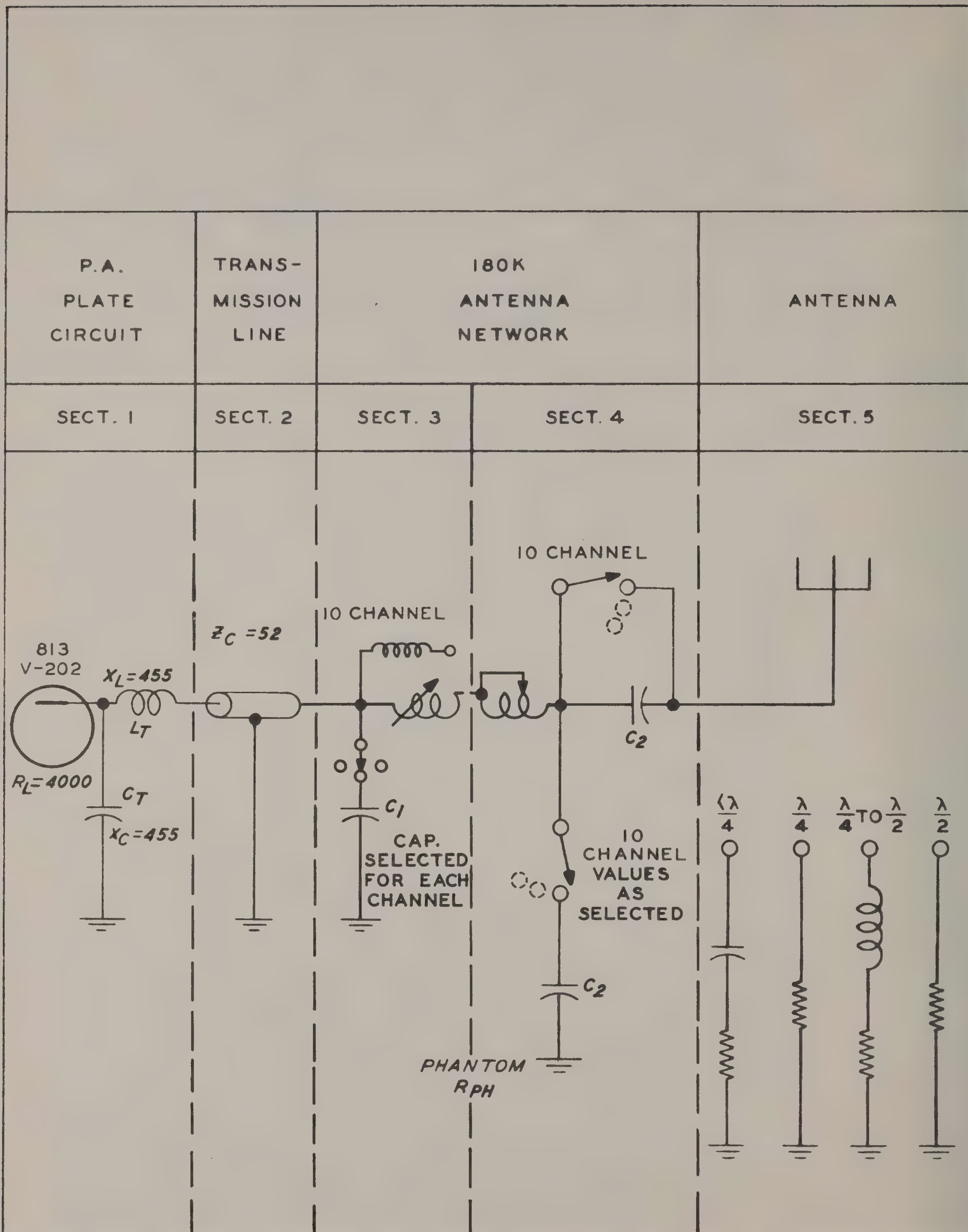


Figure 3-6 Model 18S Output Network Theory Chart

where X_a is negative (capacitive)

$$R_{ph}' = \frac{(X_L)^2}{R_a \text{ equiv.}} \qquad \text{and } R_{ph} = R_{ph}' + \frac{X_L}{Q}$$

Trial calculations of L and R_{ph} must be made until a value of L within range of the network inductors and a value of R_{ph} less than 52 ohms are obtained.

Transformation of R_{ph} to 52 ohms is performed in Section 3 as previously described.

CALCULATION EXAMPLES:

The following calculation examples illustrate the calculation procedure as outlined for the various classes of antenna operation. The antenna data used has been taken from figure 3-5. A "Q" of 100 is used in these calculations.

The following formulas give inductive and capacitive reactances in terms of practical units.

$$X_L = 6.28\ F_L \qquad L = \frac{X_{X_L}}{6.28\ F}$$

$$X_c = \frac{159{,}000}{F_C} \qquad C = \frac{159{,}000}{X_c F}$$

where X = reactance in ohms
L = inductance in microhenries
C = capacitance in micro micro farads.
F = frequency in mc/s.

Class 1 Antenna

Z_A = 1.7 - J350 at 2.7 mc.

Section 4, X_L = 350 ohms $\qquad$ $R_L = \frac{350}{100} = 3.5$ ohms.

$$L = \frac{350}{6.28 \times 2.7} = 20.6\ \mu h$$

$$R_{ph} = R_A + R_L = 1.7 + 3.5 = 5.2 \text{ ohms}$$

Section 3.

$$X_C = X_L = \sqrt{52 \times 5.7} = \sqrt{296} = 17.4 \text{ ohms}$$

$$C = \frac{159,000}{2.7 \times 17.4} = 3,380 \text{ mmf.}$$

$$L = \frac{17.4}{6.28 \times 2.7} = 1.03\ \mu h.$$

Total network $L = 20.6 + 1.03 = 21.63\ \mu h.$

Class 2 Antenna

$$Z_A = 4.3 + J0 \text{ at } 4.93 \text{ mc.}$$

Section 3. Assuming no elements in Section 4, $R_{ph} = 4.3$ ohms.

$$X_C = X_L = \sqrt{52 \times 4.3} = 15.3 \text{ ohms.}$$

However, minimum available inductive reactance is

$$X_L \text{ Min} = 6.28 \times 4.93 \times 1.5 = 46.5 \text{ ohms.}$$

Hence, a series capacitor must be used in Section 4.

Section 4. Using maximum capacitance readily available (three 67 mmf capacitors in parallel)

$$X_C = \frac{159,000}{4.93 \times 201} = 162 \text{ ohms.}$$

$$L = \frac{162}{6.28 \times 4.93} = 5.23\ \mu h.$$

$$R_L = \frac{162}{100} = 1.62 \text{ ohms.}$$

$$R_{ph} = 4.3 + 1.62 = 5.92 \text{ ohms.}$$

Section 3 (recomputed):

$X_L = X_C = \sqrt{52 \times 5.92} = 17.6$ ohms.

$C = \dfrac{159{,}000}{17.6 \times 4.93} = 1830$ mmf.

$L = \dfrac{17.6}{6.28 \times 4.93} = 0.57\ \mu$h.

Total network $L = 5.23 + 0.57 = 5.80\ \mu$h.

Class 3 Antenna:

$Z_a = 9 + J200$ at 6.0 mc.

Section 4. Minimum available inductive reactance.

X_L Min. $= 6.28 \times 6.0 \times 1.5 = 56.5$ ohms.

Series $X_C = X_a + X_L$ Min. $= 200 \times 56.5 = 256.5$ ohms.

$C = \dfrac{159{,}000}{6.0 \times 256.5} = 103$ mmf.

$R_L = \dfrac{X_L}{Q} = \dfrac{56.5}{100} = 0.56$ ohms.

$R_{ph} = R_a + R_L = 9.56$ ohms.

To calculate voltage across series capacitor,

$I_a = \sqrt{\dfrac{P}{R_{ph}}} = \sqrt{\dfrac{100}{9.56}} = 3.3$ amperes

$V_C = X_C\, I_a = 256.5 \times 3.3 = 486$ volts.

Section 3.

$X_L = X_C = \sqrt{52 \times 9.56} = 22.4$ ohms.

$C = \dfrac{159{,}000}{6.0 \times 22.4} = 1180$ mmf.

$L = \dfrac{22.4}{6.28 \times 6.0} = 0.59\ \mu h.$

Total $L = 1.5 + 0.59 + 2.09\ \mu h.$

<u>Class 4 Antenna</u>

Example 1. $Z_a = 300 + J2500$ at 7.9 mc.

Section 4.

Calculate R_a equiv. $= \dfrac{(X_a)^2}{R_a}$

R_a equiv. $= \dfrac{(2500)^2}{300} = 20{,}800$ ohms.

Calculate L using $L = X_{(C2 + 30)} \left(\dfrac{X_a}{X_a - X_{(C2 + 30)}} \right)$

Try $C_2 = 100$ mmf $X_{C2 + 30} = 157$ ohms.

$L = 157 \dfrac{2500}{2500 - 157} = 167$ ohms.

L - 3.4 microhenries.

This might be considered too close to the minimum variometer reactance available.

Try $C_2 = 67\ \mu\ \mu f$ $\qquad X_{C2 + 30} = 208$ ohms.

$L = 208 \dfrac{2500}{2500 - 208} = 227$ ohms.

$L = 4.55$ microhenries.

$$R_{ph'} = \frac{(X_L)^2}{R_a \text{ equiv.}} = \frac{(227)^2}{20{,}800} = 2.47 \text{ ohms.}$$

$$R_{ph} = R_{ph}' + R_L \qquad R_L = \frac{X_L}{Q} = \frac{227}{100} = 2.27$$

$$R_{ph} = 2.47 + 2.27 = 4.74 \text{ ohms.}$$

Section 3.

$$X_L = X_C = \sqrt{52\ R_{ph}} = \sqrt{52 \times 4.47} = 15.7 \text{ ohms.}$$

$C = 1270$ mmf.

$L = 0.315$ microhenries.

Total network $L = 4.55 + 0.315 = 4.865$ microhenries.

Example 2.

$Z_a = 420 - J1170$ at 18.0 mc.

Section 4.

$$R_a \text{ equiv.} = \frac{(1170)^2}{420} = 3.250 \text{ ohms.}$$

Try $C_2 = 10$ mmf.

$X_{C2 + 30} = 221$ ohms.

$$L = 221 \left(\frac{1170}{1170 + 21}\right) = 1.85 \text{ microhenries}$$

$$R_{ph'} = \frac{(221)^2}{3250} = 15.1 \text{ ohms.}$$

$R_{ph} = 15.1 + 2.21 = 17.31$ ohms.

Section 3.

Using formulas for R_{ph} from 10 to 52 ohms.

$$X_C = \frac{52}{\sqrt{\frac{52}{17.31} - 1}} = 36.8 \text{ ohms.}$$

C = 240 mmf.

$$X_L = 36.8\sqrt{\frac{52}{R_{ph}} - 1} = 52 \text{ ohms.}$$

L = 0.46 microhenries.

Total network L = 1.85 + 0.46 = 2.31 microhenries.

(4) INSTALLATION OF NETWORK COMPONENTS AND WIRING.

(a) INPUT CAPACITORS. - The input capacitors C-501 through C-510, are mounted on the mounting panel on the front of the unit using the studs provided. Two capacitors of the type recommended can be mounted on each pair of studs, if it is necessary to do so to obtain the proper value of capacity.

(b) OUTPUT CAPACITORS. - The series or shunt output capacitors are mounted on the panel provided for them by means of screws and lockwashers.

(c) NETWORK WIRING. - Network switch S-501 must be wired to connect the various network elements in the desired configuration for each channel. Each section of this switch has a specific function as follows:

S-501A. - The terminals of S-501A are permanently wired to the input capacitor mounting panel to select the input capacitor chosen for each channel.

S-501B. - The rotor of S-501B is permanently connected to ground. The terminals of this section are used to ground the output capacitor in the case of a "pi" network or the static drain choke when the "L" network with series capacitance is used.

S-501C. - The rotor of S-501C is permanently connected to the junction of L-501 and L-503. Its terminals are used to connect L-502 in parallel with L-501 when a low range of variable inductance is to be used.

S-501D. - S-501D controls the connection of L-503. Its rotor is also connected to the junction of L-501 and L-503. When all the coil is to be used in series with variometer L-501, no connection to the switch is made. When one-half the coil is to be used, the switch terminal is connected to the tap of L-503. When no series inductor is to be used, the switch terminal is connected to the end terminal of L-503.

S-501E. - The rotor of S-501E is connected to antenna connector J-502. When the "pi" or standard "L" network is to be used, the channel terminal of this switch is connected to the end terminal of L-503. When the "L" network with series capacitance is used, the switch terminal is connected to the terminal of the series capacitor.

All network wiring should be done using No. 14 A.W.G. tinned copper wire. Clearance of at least one-half inch between wires should be maintained. Sharp points on the ends of wires or on soldered connections should be rounded by means of a file to avoid possible corona at high altitudes. Soldering should be very thoroughly performed to prevent the possibility of loose connections because of vibration or shock.

(5) FINAL ADJUSTMENT. - Final adjustments of the Type 180K-3 Antenna Matching Network must be made with the unit installed in the airplane and connected to the antenna and transmitter. These adjustments include tuning the variometer and making any changes in components which may be necessary.

As mentioned previously, the proper setting of the variometer is that, which produces the best impedance match as indicated by the standing wave ratio indicator, M-501. A good match as thus indicated can usually be obtained with several values of network input capacitor. The transmitter plate current, however, will vary appreciably as the input capacitor is varied. The proper choice of input capacitor is that which produces a low S.W.R. Indicator reading and proper transmitter plate current indication.

When two frequencies are to be used on a single channel, compromise settings which produce a reasonably good match for both frequencies should be chosen.

When all adjustments have been completed, the S.W.R. Indicator Sensitivity Control should be set to minimum sensitivity to prevent possible damage to the meter. The TEST switch must be set to ON before the front cover is replaced.

SECTION 4

OPERATION

This section contains only the steps that are necessary to control the equipment for routine operation. It is suggested that the operator refer to the ADJUSTMENT SECTION of this instruction book for a more detailed explanation of the procedure to be followed for the adjustment of the circuits.

Since this equipment is designed to work from various types of control boxes or panels which are to be furnished by the customer, the nomenclature used here for the controls may not be entirely as engraved on the control panels. The operator will have to consult the complete schematic diagram of the equipment, in event the nomenclatures are different to correlate the functions with the nomenclatures.

1. STARTING THE EQUIPMENT.

a. Place the ON-OFF switch in the ON position.

b. Place the Function Selector switch in the PHONE position for PHONE operation; in the CW position for CW operation.

c. Press the push-to-talk button on the microphone for PHONE operation; press the key for CW operation.

2. STOPPING THE EQUIPMENT.

a. Place the ON-OFF switch in the OFF position.

3. GENERAL.

This equipment is designed for transmission and reception of radio signals for communication purposes on frequencies designated by the Federal Communications Commission and on which the equipment is licensed. The equipment has a maximum of 20 operating frequencies selected by a CHANNEL SELECTOR switch. A frequency versus channel chart should be placed near the operating position for the convenience of the operator. Refer to the ADJUSTMENT SECTION paragraph 2.b of this instruction book for the functions of the controls.

The audio section of this equipment may also be used for interphone purposes.

4. ROUTINE OPERATION.

a. TRANSMIT-RECEIVE.

(1) Place the ON-OFF switch in the ON position. (Allow the tube heaters a few seconds to come to operating temperature.)

(2) Place the Function Selector, CW switch in the PHONE position for PHONE operation; in the CW position for CW operation.

(3) Rotate the BFO tone control to turn BFO ON if CW reception is desired.

(4) Select the proper channel with the CHANNEL SELECTION switch.

(5) Allow the frequency selecting mechanism to operate.

(6) Press the push-to-talk button for PHONE operation, press the telegraph key for CW operation.

b. INTERPHONE.

(1) Place the Function Selector switch in the STD BY position.

(2) Press the push-to-talk button on the microphone.

(3) Place the ON-OFF switch in the OFF position to turn the equipment off.

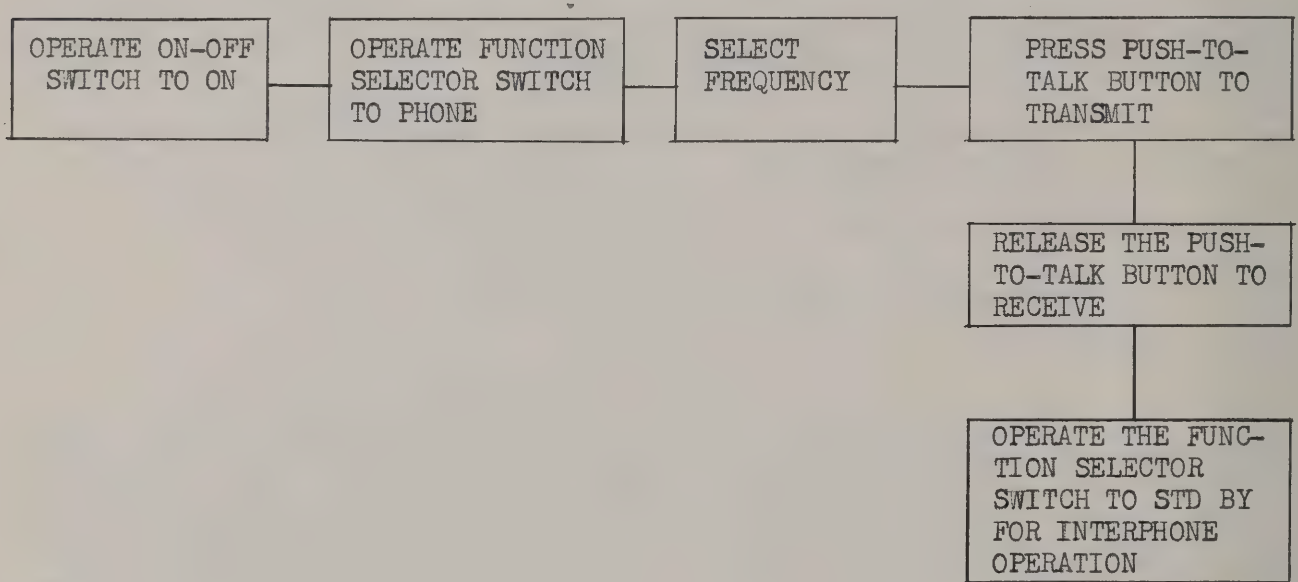


Figure 4-2 Operating Sequence Block Diagram (Phone Operation)

SECTION 5

MAINTENANCE

1. INSPECTION.

a. GENERAL. - This radio equipment has been constructed of materials considered to be the best obtainable for the purpose and has been carefully inspected and adjusted at the factory to reduce maintenance to a minimum. However, a certain amount of checking and servicing will be necessary to maintain efficient and dependable operation. The following sections have been written to aid in checking the equipment.

b. PREFLIGHT INSPECTION. - The purpose of the preflight inspection is to make certain that the equipment is functioning properly and that all parts are securely fastened.

(1) VISUAL INSPECTION.

(a) Check tightness of the AUTOTUNE locking key on the variometer control in the antenna matching unit.

(b) Check the antenna and antenna terminal connection.

(c) Check the mounting base and make certain that it is securely fastened and grounded to the structure of the aircraft.

(d) Check the condition of the securing clamps on the mounting base and the safety wires that hold the clamp nuts in place.

(e) Check all of the interconnecting wires. If necessary, hand-tighten all of the plug locking rings. Inspect the interconnecting wires for breaks and loose connections at the plugs.

(f) Check the headphones for loose or broken wire.

(g) Make all other checks that may aid in accomplishing the purpose of this inspection.

(2) OPERATIONAL CHECK. - Before each flight, the operation of the equipment should be checked. The following operational checks will indicate whether or not the equipment is operating normally.

(a) Operate the ON-OFF switch to the ON position and allow a few seconds for the tubes to warm up.

(b) Place the Function Selector switch in the STD-BY position and speak into the microphone while listening to the interphone output.

(c) Rotate the meter selector switch to the BATTERY position and check the battery voltage.

(d) Rotate the CHANNEL SELECTOR switch to all 20 positions to check the band change mechanism. Press the push-to-talk button on each channel position and observe the PA PLATE current reading and the PA GRID current reading.

(e) Check the r-f output on all channels. This check and the following one should be made outside of the hanger.

(f) Check the receiver operation on each channel.

c. 100 HOUR INSPECTION.

(1) GENERAL. - This inspection involves removal of the chassis and should be a thorough and searching visual and operating inspection designed to determine the amount of service that is required and to detect maladjustment and early stages of deterioration of components.

(2) REMOVING TRANSMITTER-RECEIVER CHASSIS. - The first step in the procedure is to remove the transmitter-receiver unit from the mounting base. Unfasten the safety wires on the two nuts at the bottom of the front panel, loosen the nuts, and unhook the catches. Slide the unit forward until the plug and plug receptacle are disengaged. Lift the unit from the mounting rack and place on a bench. Disengage the two Dzus fasteners with a screwdriver or the edge of a coin. Pull the unit forward and out of the cabinet.

(3) VISUAL INSPECTION.

(a) Check the tubes to see that they are tight in their sockets.

(b) Check all moving parts for wear.

(c) Check the capacitors, resistors and other components for corrosion and deterioration.

(d) Check all parts for looseness due to vibration.

(e) Check relay and switch contacts for corrosion and pits.

(f) Make the above checks, which apply, on the Model 180K-3 Antenna Matching Network Unit.

(4) OPERATIONAL INSPECTION.

(a) Check the tuning of the coils in the transmitter and receiver r-f circuits.

(b) Check the i-f alignment of the receiver.

(c) Check the power output of the transmitter into a 52 ohm non-inductive load attached to the coaxial line connector.

(d) Check the operation of the band-change apparatus.

NOTE

Refer to paragraphs 5., e. in this section for a detailed explanation of test procedures and equipment used in the above checks.

d. ANNUAL INSPECTION. - The annual inspection may include all inspection checks given in paragraphs a., b., and c. in addition to the following checks.

(1) Check all tubes and replace those found weak or defective. Some operators prefer to change all tubes after 1000 hours operation.

(2) Remove the dynamotor and inspect the brushes and commutator.

2. VACUUM TUBES.

a. PRECAUTIONS FOR SATISFACTORY TUBE LIFE.

(1) Before any tube is removed from the equipment make certain the unit is disconnected from the power source.

(2) The primary power source must not exceed 32 volts (Normal voltage is 28 volts.)

(3) Operate all tubes within 5% of the rated voltages.

(4) Do not exceed the rated plate current of any of the tubes during normal operation of the equipment.

b. TUBE REPLACEMENT PRECAUTIONS.

(1) Loosen tube clamps on V201, V204 and V205 before attempting to replace these tubes.

(2) All tubes are removed by pulling straight up on them.

(3) Before a tube is replaced, make certain that the type of tube is correct for the socket into which it is being placed.

(4) When replacing the tubes, properly orient the tube pins with respect to the socket and push into place.

(5) Do not attempt to operate the equipment without tube shields on those tubes so equipped.

c. REPLACEMENT OF TUBES. - Before a tube is discarded, make certain that the tube is at fault and that the trouble is not a loose or broken connection in the equipment. When a tube is known to be defective it should be disposed of immediately so that the tube will not become mixed with good tubes from general stock. Discard all tubes with open heaters, shorted or noisy elements, low emission, or any other defect which would cause faulty operation of the equipment. If the tubes have been in use for a year, it is suggested that they be replaced. A marked improvement in performance of the equipment is usually noticeable after the weak tubes have been replaced.

NOTE

This equipment has been tested and adjusted with RCA, GE or Kenrad type 813 tubes. Tubes made by these manufacturers should be employed.

3. TROUBLE LOCATING IN INSTALLED EQUIPMENT.

a. GENERAL. - In case of trouble, look for simple causes first. Analyze and isolate the difficulty before attempting to remove or dismantle any part of the equipment. A few moments of thought and study of various possible causes of failure may save hours of haphazard labor. Radio equipment is often damaged by needless disassembly or removal of parts.

b. LOCATING TROUBLE. - Before the equipment is removed from the aircraft, the trouble should be determined, if possible. The checks in the following trouble locating chart should be made to locate the trouble which can be repaired without removing the unit. If the trouble cannot be located and repaired by the following checks, the unit must be removed from the aircraft and taken to a repair bench.

CASE	SYMPTOMS	POSSIBLE CAUSE OF TROUBLE
1.	AUTOTUNE mechanism does not operate and dynamotor does not rotate.	1. No input voltage 2. Power source voltage too low. 3. Bad cable connections.
2.	No signal received.	1. Antenna open or short circuited. 2. Defective headphones. 3. Defective crystal. 4. Bad cable connections.

CASE	SYMPTOMS	POSSIBLE CAUSE OF TROUBLE
3.	Band Change mechanism won't function.	1. See Case 1. above. 2. Loose or broken connections in cable system.
4.	Excessive PA PLATE current	1. Defective crystal. 2. Defective oscillator or amplifier tube.
5.	Abnormal or subnormal PA PLATE current. Normal grid current	1. Antenna open or shorted. 2. Faulty output coil connection. 3. Improper PA tuning.
6.	Power Control relays will not operate.	1. Front cover of 180K unit off and TEST switch in OFF position. 2. See Case 1. above. 3. Faulty microphone switch. 4. Dirty relay contacts.

4. TROUBLE LOCATING AT TEST BENCH.

a. PRELIMINARY CHECKS. - The following preliminary checks may be easily performed to locate trouble in the equipment.

(1) EQUIPMENT REQUIRED.

(a) Power source - 28 volts d-c.

(b) Power and control cables equipped with connectors identical to those used in the shockmount and transmission line.

(c) Voltmeter - 0-10, 0-100, 0-1500 volts d-c.

(d) Ohmmeter - 0-10 ohms, 0-100,000 ohms, 0-5 megohms

(e) Spare tubes.

(f) Dummy loads.

(g) Interconnecting terminal board identical to the terminal board on the shockmount.

(2) REMOVING THE EQUIPMENT.

(a) TRANSMITTER-RECEIVER. - Remove the transmitter-receiver unit from the mounting base and the cabinet as outlined in paragraph 1., c., (2) in this section.

(b) 180K-3 ANTENNA MATCHING NETWORK UNIT. - If the trouble appears to be in the transmitter-receiver unit only, it will be unnecessary to remove the antenna matching network unit from the aircraft. A dummy load of 52 ohms may be attached to the coaxial line connector and a jumper placed across terminals 36 and 37 of the interconnecting terminal board.

(3) PRELIMINARY TROUBLE LOCATING CHART.

CASE	SYMPTOMS	POSSIBLE CAUSE OF TROUBLE
1.	Equipment dead.	1. Defective ON-OFF switch.
2.	AUTOTUNE operative but. dynamotor does not run.	1. Defective brushes in dynamotor. 2. Dynamotor windings open. 3. Open circuit in winding. 4. See Case 1. 5. Defective Dynamotor Control Solenoid.
3.	Will not change channels.	1. Defective Channel Selector Switch. 2. Defective Motor B101. 3. Relay K102 not closing. 4. Dirty contacts on relay K102.
4.	No signals received.	1. Defective tubes. 2. Crystal not oscillating. 3. Defective ON-OFF switch. 4. Dirty NC contacts mic. relay K101. 5. Defective components. 6. Slug in coil moved and detuning results.
5.	No receiver plate voltage.	1. Defective ON-OFF switch. 2. Shorted C101 capacitor.
6.	No PA GRID current.	1. Defective oscillator tube or crystal. 2. Power amplifier grid circuit open. 3. Defective or detuned oscillator tuning components.

CASE	SYMPTOMS	POSSIBLE CAUSE OF TROUBLE
7.	AUTOTUNE does not position but keeps seeking.	1. AUTOTUNE out of synchronism. 2. Failure of relay K102. 3. Failure of switch S102.
8.	Receiver noisy.	1. Defective tube. 2. Loose wiring connection. 3. Open bypass capacitor. 4. Defective switch contacts.
9.	Oscillation in receiver.	1. Open bypass capacitor. 2. Defective ground connections. 3. Defective tube.
10.	Received signals weak.	1. Weak tubes. 2. Low plate voltage. 3. Improper alignment of circuits.

5. SPECIAL MAINTENANCE.

a. MECHANICAL ADJUSTMENT.

(1) AUTOTUNE SYNCHRONIZATION. - In event the AUTOTUNE unit should become out of synchronization as indicated by the unit continuing to run after the band switch has been positioned, it will be necessary to re-synchronize the unit as follows:

(a) Remove the channel indicator dial from the seeking switch shaft.

(b) Loosen the 6-32 Phillips head screw which is directly under the channel dial. This screw locks the seeking switch mounting plate in the proper position after synchronization.

(c) Rotate the seeking switch mounting plate to the extreme counterclockwise position.

(d) Turn the channel selector switch to channel number 5 and apply power to the AUTOTUNE.

(e) The AUTOTUNE will start to operate and, if the unit is very far out of synchronization, will continue to recycle.

(f) Rotate the seeking switch plate slowly in the clockwise direction until the AUTOTUNE stops and sets up on position number 5.

(g) Look through the slot in the AUTOTUNE front plate and observe the square notch cut into the seeking switch rotor contact. This is a small notch approximately 3/64" square. Turn the seeking switch plate in the clockwise direction until the square notch is exactly centered on the white line which can be seen extending from the outside edge to the inside edge of the seeking switch stator plate.

NOTE

The seeking switch plate must be rotated to its final setting in the clockwise direction, therefore, if the plate is moved too far, do not attempt to correct the adjustment; instead, move the plate completely back to the counterclockwise position and start over.

(h) Lock the seeking switch plate by turning the Phillips head screw clockwise until tight.

(i) Replace the channel indicator dial and set it to position number 5.

(j) Check the synchronization on all channels.

(2) Should repairs become necessary on the band switch or variometer mechanisms in the Model 180K-3 Antenna Loading Unit and the above mentioned mechanisms become out of synchronism with the AUTOTUNE unit, the following procedure can be used to re-establish synchronism.

(a) With the covers removed from the 180K-3 unit and the unit connected for operation, rotate the channel selector switch to channel number one.

(b) After the AUTOTUNE unit has completed its cycle, unlock the TUNING control and turn the variometer rotor (by means of the TUNING knob) until the rotor is in the inductance "aiding" position.

(c) Loosen the set screws on the TUNING dial and set the dial to the "0", after which, tighten the set screws again.

(d) Loosen the set screws in the band switch spur gear and turn the band switch rotor until tap number one is contacted by the switch rotor. Tap number one can be found by a continuity check between the center contact on J-501 and the hot terminal of C510. Refer to the 180K schematic, figure 8-14.

(e) Check to be sure that the rotor contact is exactly centered on the stator contact and then tighten the set screws in the band switch spur gear.

(f) The synchronism procedure is now completed and may be checked on each channel for accuracy.

(g) Check the contact pressure on each rotor contact with a contact pressure scale and set the contact pressure between 2.5 and 5 ounces using a relay contact tool to adjust the pressure. Be sure there is at least 1/16 inch clearance between the switch rotor and the nearest switch stator; this can be adjusted by loosening the rotor arm set screws and sliding the rotor arm.

b. LUBRICATION. - The following chart indicates the parts to be lubricated, the type of lubrication to be used, the method of lubrication, and the lubrication period. A part may be lubricated more often if there is a need for it, however, be sure and wipe off all excess lubricant.

LUBRICATION CHART

ASSEMBLY	PART	CODE	LUBRICANT MFR. AND MFR'S TYPE	LUBRICATION PERIOD	PROCEDURE
AUTOTUNE UNIT	PAWL STACK	D	DOW CORNING #7	Annually	Apply sparingly with camel hair brush. Remove excess lubricant.
AUTOTUNE UNIT	FELT WASHERS	A	STANDARD OIL CO. of N.J. BE-19584	Annually	Saturate.
AUTOTUNE UNIT	SPUR GEARS	C	SOCONY VACUUM PD-535A	Anually	Apply sparingly with camel hair brush. Remove excess lubricant.
AUTOTUNE UNIT	LINE SHAFT GEAR BOX	B	STANDARD OIL CO of N.Y. BRB #2	*	Fill gear box.
AUTOTUNE UNIT	SEEKING SWITCH CONTACTS	D	DOW CORNING #7	Annually	Apply sparingly with camel hair brush. Remove Excess lubricant.

* Refill only if grease becomes contaminated.

LUBRICATION CHART

ASSEMBLY	PART	CODE	LUBRICANT MFR. AND MFR'S TYPE	LUBRICATION PERIOD	PROCEDURE
AUTOTUNE UNIT	BALL BEARINGS	D	DOW CORNING #7	Annually	Coat races, also ball and cage assy.
AUTOTUNE UNIT	OILITE BEARINGS	A	STANDARD OIL CO. of N.J. BE-19584	Annually	Apply only amount bearing will retain.
AUTOTUNE UNIT	CAM SHAFT	A	STANDARD OIL CO. of N.J. BE-19584	Annually	Saturate felt washers.
AUTOTUNE UNIT	TUNING SHAFT BEARINGS	A	STANDARD OIL CO. of N.J. BE-19584	Annually	One drop on each end.
AUTOTUNE UNIT	SEEKING SWITCH BEARING	A	STANDARD OIL CO. of N.J. BE-19584	Annually	Saturate felt washer.
S501	SELECTOR SWITCH BEARINGS	A	STANDARD OIL CO. of N.J. BE-19584	Annually	Apply only amount bearing will retain.
L503	FRONT BEARING	A	STANDARD OIL CO. of N.J. BE-19584	Annually	Apply only amount bearing will retain.
S101	CONTACTS	E	FIST BROS. LUBRIPLATE #105	Annually	Apply sparingly with camel hair brush. Remove excess lubricant.
ANTENNA UNIT	SPUR GEARS	C	SOCONY VACUUM PD-535A	Annually	Apply sparingly with camel hair brush. Remove excess lubricant.

c. DYNAMOTOR AND MOTOR MAINTENANCE.

(1) DYNAMOTOR MAINTENANCE.

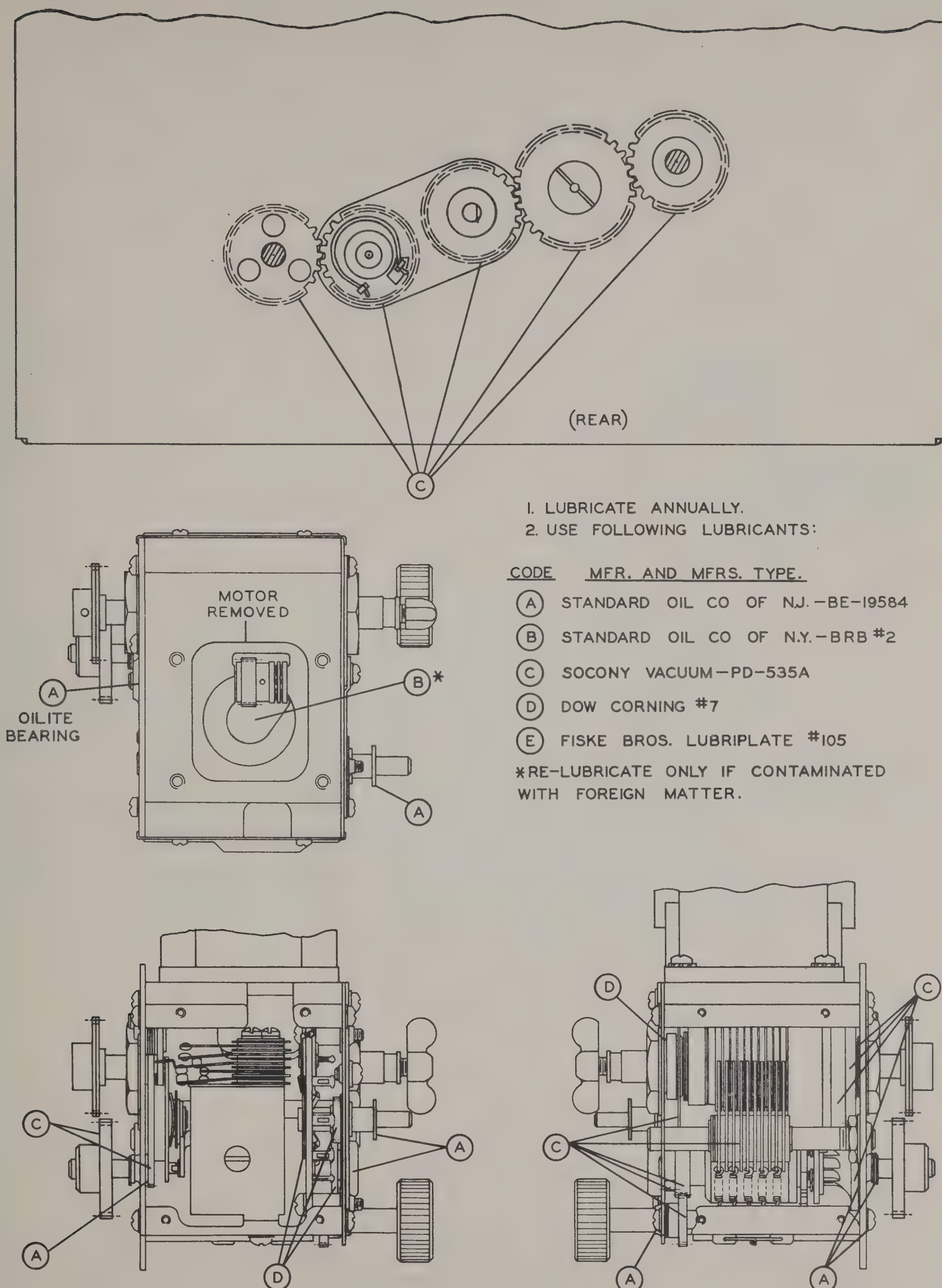


Figure 5-1 Lubrication Drawing

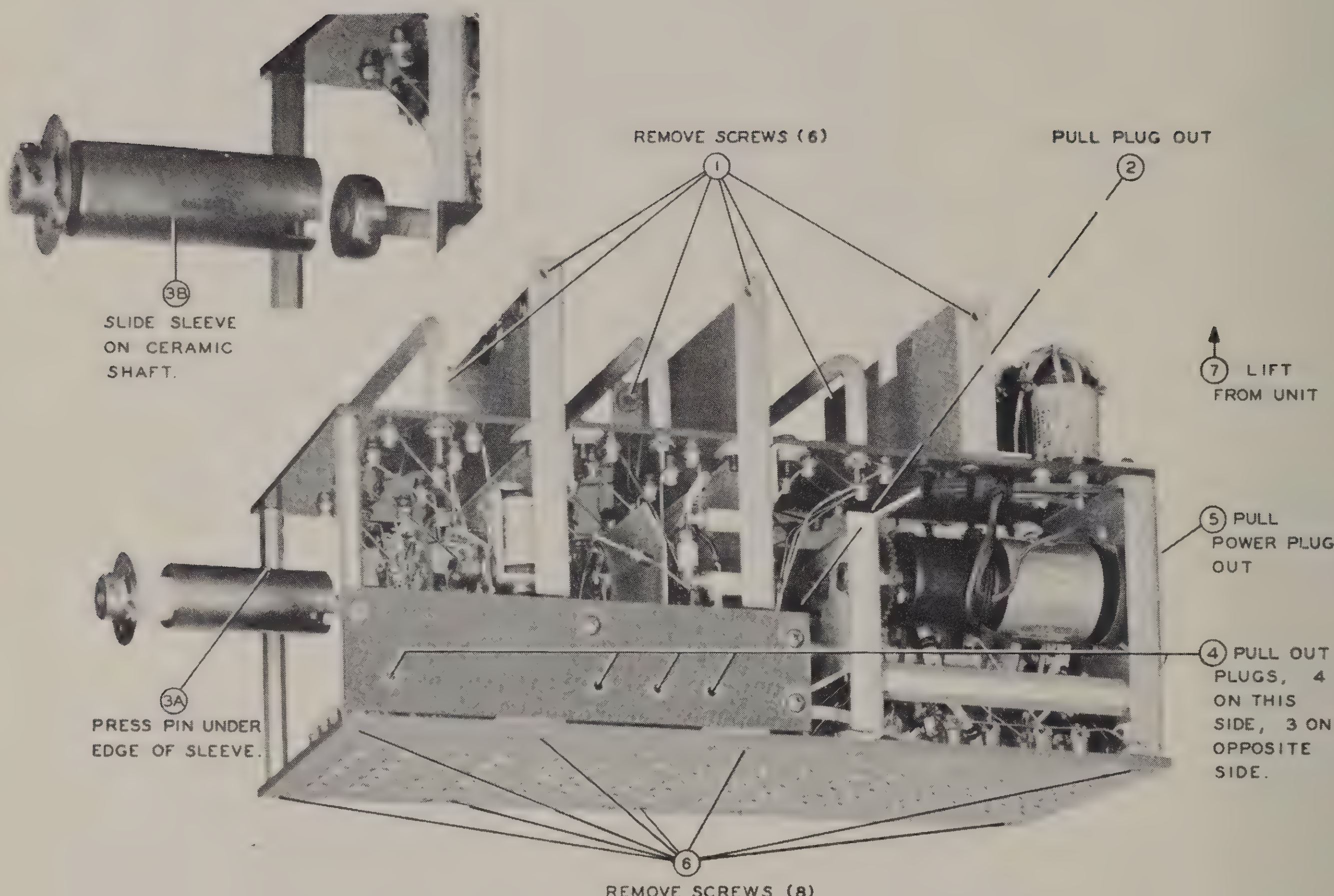


FIGURE 5-2 EXCITER REMOVAL PROCEDURE

(a) LUBRICATION. - The dynamotor bearings are lubricated for the life of the machine, therefore, require no attention.

(b) BRUSHES. - Replace dynamotor brushes when they are worn to a length of 1/4 inch or when the spring is known to be defective. A weak spring can cause arcing and loss of power.

The part numbers for the brushes are as follows:

± PRI	±400 v	±750 v
234 0117 00	234 0119 00	234 0118 00

(2) MOTOR MAINTENANCE.

(a) AUTOTUNE MOTOR.

1. LUBRICATION. - No special lubrication necessary.

2. BRUSHES. - Replace when 1/4" in length or when the spring is known to be defective. Replacement brushes part # (+) 234 0146 00
(-) 234 0147 00

(b) BAND CHANGE MOTOR.

1. LUBRICATION. - No special lubrication necessary.

2. BRUSHES. - Replace when 1/4" in length or when the spring is known to be defective. Replacement brushes part # 234 0145 00.

(c) RELAYS. - All relays should be inspected at regular intervals. Check the contacts for proper alignment, pitting and corrosion. Use a burnishing tool to clean the contacts - never use sandpaper or emery cloth.

d. ELECTRICAL ADJUSTMENT.

(1) CHANGING FREQUENCY.

(a) TRANSMITTER SECTION. - If it is desired to change the frequency of any channel, it may be necessary to change coils in the exciter stages of the transmitter and readjust the final amplifier tuning circuit. If the new frequency is within a few kilocycles of the old frequency, it is likely that the old coils will be adequate. Plug the new crystal into the correct position for the new frequency and attempt to tune the various stages to resonance. If it is impossible to tune the transmitter with the old coils a new set of coils for the new frequency may be obtained from The Collins Radio Company, see chart of Coil Numbers vs Frequency Ranges in SECTION 6, also refer to figure 5-4. The transmitter exciter coils may be removed by pulling straight up on the coil after removing the screw that secures the top of the coil to the ground bus.

The power amplifier tank coils are equipped with taps to change the inductance, therefore, if the new frequency is near the old one, the old tap may be useable. If, however, the new frequency is quite different than the old one, a change of taps may be necessary. See Output Circuit Frequency Chart in SECTION 6.

(b) RECEIVER SECTION. - When changing the frequency of any channel in the receiver, it is necessary to change the crystal and two coils, the r-f coil and the mixer coil. It should be remembered that the crystals are ground for a fundamental or harmonic frequency 455 kc higher or lower (depending on frequency to be received) than the channel frequency.

The r-f and mixer coils can be removed, if new coils are necessary, in the same manner as the transmitter exciter coils. The radio frequency portion of the receiver may be aligned by following instructions outlined paragraph 5., e, (3). See chart of Coil Numbers vs Frequency Ranges in SECTION 6 and figure 5-5.

(2) TRANSMITTER ALIGNMENT.

(a) GENERAL. - If a channel frequency has been changed or there is evidence that the transmitter circuits are out of alignment, it will be necessary to align all of the transmitter circuits. It will not be necessary to have the antenna matching network connected for these adjustments, rather a 52 ohm non-inductive resistor of sufficient rating to withstand the transmitter output should be connected to the coaxial transmission line connector. A jumper will have to be placed across terminals 36 and 37 on the interconnecting terminal board in order to complete the relay circuits. Proceed as follows to align the transmitter circuits.

1. Make power, control and dummy load connections. (Be sure primary source is full 28v).

2. Check to see that the proper crystal is in the socket corresponding to the channel being aligned.

3. Operate the ON-OFF switch to the ON position.

WARNING

Operating personnel must at all times observe all safety regulations. Do not change tubes with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the OFF position due to charges retained by capacitors. To avoid casualties always remove power, discharge, and ground circuits prior to touching them.

4. Place the Function Selector switch in the PHONE position.

5. Rotate the meter selector switch to the PA GRID position.

6. Press the push-to-talk switch and adjust the involved buffer-doubler tank slug for mid-scale meter reading.* Since the full plate voltage is also being applied to the PA tube, hold the push-to-talk button down only for short intervals so as to not damage the PA tube. Make tuning adjustments with an insulated screwdriver. Remember that an excess of 1100 volts is being applied to some of the transmitter circuits.

7. After the grid current has been tuned to mid-scale for one channel, the remaining bands may be aligned in like manner. The grid meter reading should be within the red area on the meter scale, never above. If, at resonance, the PA GRID current is above the red area, detune the buffer-doubler tank coil by adjusting the slug out of the coil until the meter reading is correct.

NOTE

L210 in the oscillator plate circuit and L200 in the plate circuit of V206 (6AG7) should be adjusted for maximum indication on a frequency of approximately 9250 KC.

8. Select a frequency which is in the center of the group of frequencies to be served by the particular power amplifier plate coil tap. (If only extremes are available, switch to one then to the other for optimum setting.)

9. Rotate the meter selector switch to the PA PLATE position.

10. Press the push-to-talk switch for short durations and tune the power amplifier plate circuit to resonance by connecting various coil taps to the S101K switch contact which corresponds to the channel being aligned. At optimum resonance, the power amplifier should be loaded to the area from the center to the upper half of the red area. If the loading is too light

*More sensitive indication can be had by using a vacuum tube voltmeter from the grid of the following stage to ground, in which case, it may be necessary to use an r-f choke between the negative test prod and the grid from which readings are taken.

or too heavy, the value of the loading capacitor will have to be changed. The loading capacitors are located under the front cover and provision is made to either add or subtract capacitors until proper loading is obtained. If the loading is too light, add more capacity and conversely, if the load is too heavy, subtract or remove capacity. The capacitors may be easily mounted and connected together from the front panel. Resonance is indicated by optimum power in the dummy load and may be checked by short circuiting the dummy load which should cause a marked reduction in PA plate current.

The power amplifier tuning is sufficiently broad to serve for any frequency with ±5% of the frequency to which the tank coil has just been tuned, however, sufficient taps are available so that finer adjustment can be had if desired. Choose the next group of frequencies and tune the next power amplifier plate tank coil tap to the center frequency of the group. After the power amplifier plate coil has been tuned and the loading is correct, the 52 ohm load and the jumper from terminals number 36 and 37 on the interconnecting terminal board may be removed and coaxial line connected to the output connector.

(3) RECEIVER ALIGNMENT.

(a) GENERAL. - A superheterodyne circuit with one stage of r-f amplication is employed in the receiver. The intermediate amplifier frequency is 455 kc, therefore, the crystals for the local oscillator must be ground for a fundamental or harmonic frequency 455 kc higher or lower than the received signal frequency, refer to paragraph 2., g. in SECTION 2. As a safety precaution, it is good practice to disconnect the white dynamotor input lead while working on the receiver section to prevent accidentally closing the relay circuit which would start the dynamotor.

(b) I-F ALIGNMENT.

1. EQUIPMENT REQUIRED.

a. Radio frequency signal generator 455 kc to 20,000 kc range with an adjustable output and capable of tone modulation. Should have low impedance output.

b. An adjustable range audio output meter to match approximately 500 ohms impedance.

c. A wide insulated adjusting tool.

2. CONDITIONS FOR ALIGNMENT.

a. ON-OFF switch in ON position.

b. Sensitivity control in full ON position.

c. Signal generator connected to mixer control grid and tuned to 455 kc with modulation set at 30% at 400 cps.

d. Audio output meter connected to either headphone jack.

e. Receiver oscillator out of oscillation. (Remove the crystal for the band to which the receiver is tuned.)

3. PROCEDURE.

a. Advance the signal generator attenuation control until a deflection is obtained on the output meter.

b. Increase the signal generator output and increase the output meter range until a point is found where a further increase in signal generator signal does not cause a corresponding increase in output meter reading. Attenuate the signal generator until a drop of several db is observed in the output meter reading. This output meter reading must not be exceeded during receiver alignment since it indicates a safe margin below the AVC threshold level.

c. Starting with i-f transformer Z104 and working toward Z102, adjust first the secondary winding and then the primary winding of each i-f transformer until all transformers have been tuned to peak output. (On Z104 through Z102 the pri. is at the top of the transformer; on Z101 the pri. is at the bottom.)

NOTE

It is possible to tune the bottom coil of the i-f transformers with the slug nearly all the way in or with the slug screw protruding about 3/4 inch. The latter condition is correct.

CAUTION

Care must be exercised to constantly attenuate the signal generator during alignment procedure so that the output meter reading does not rise above the level determined in step b. Failure to do this may result in misalignment of the i-f circuits.

(c) R-F ALIGNMENT.

1. EQUIPMENT REQUIRED. - Use the same equipment as used in the adjustment of the i-f amplifiers. See paragraph 5., e., (3), (b), 1.

2. CONDITIONS FOR ALIGNMENT.

a. ON-OFF switch in the ON position.

b. Sensitivity control in full ON position.

c. Signal generator connected to the coaxial transmission line connector receptacle.

d. Audio output meter connected to headphone jack.

e. Signal generator set at the frequency corresponding to the frequency indicated by the channel selector with the output modulated 30% at 400 cps.

f. The fundamental or second harmonic of the crystal used for the channel being aligned must be ±455 kc from the channel frequency, see paragraph 2., g., in SECTION 2.

3. PROCEDURE.

a. Advance the attenuator control on the signal generator until a deflection is obtained on the output meter.

b. Increase the signal generator output until the threshold level of the AVC is found as outlined in step b, of the i-f adjustment PROCEDURE.

c. Using a small insulated adjusting tool, turn the slug in the mixer coil until maximum output is obtained.

d. Repeat step c. with the r-f coil.

CAUTION

Be sure and maintain the output level below the AVC threshold level by attenuating the output of the signal generator.

e. Repeat the above procedure for all channels.

6. REMOVABLE ASSEMBLIES.

a. GENERAL. - The time and effort in servicing the Model 18S-4 equipment is greatly reduced by the inclusion of several removable assemblies such as the

exciter assembly and the final amplifier tuning assembly. The following instructions give the steps necessary to remove the above mentioned assemblies from the major unit.

b. EXCITER ASSEMBLY. See figure 5-2. - The exciter assembly is located in the center of the 18S-4 unit and consists of the receiver coils, the transmitter exciter coils, band change switches, crystal mounting plate and other components. To remove the exciter assembly from the major unit, proceed as follows:

(1) With the dust cover off, turn the 18S-4 unit right side up and remove the six screws which hold the exciter and exciter top cover in place and remove the cover.

(2) Disengage the small banana plug connector located at the left side of the exciter unit (near the type 1625 tube).

(3) Disconnect the flexible coupler from the exciter band change switch shaft by pressing the spring loaded pin (the pin closest the power amplifier switch pies) into the ceramic shaft and sliding the coupler sleeve back far enough to disengage the pins on the exciter band switch shaft.

(4) Turn the chassis over and disengage the small banana plug connections. There are three of these connections on the left side (viewed from the front of the unit) and 4 on the right side.

(5) Disengage the multi-terminal connector at the rear of the exciter unit.

(6) Remove the 8 screws located along the bottom lip of the exciter assembly which fasten the exciter unit interior to the outside shield.

(7) Lift the exciter interior from the chassis.

NOTE

When reassembling the exciter, notice that the pin in the exciter switch shaft is of different diameters on each end, therefore, the coupler sleeve must be rotated until the proper slot mates with the proper pin thus the exciter switch and the power amplifier switch will be synchronized with each other.

c. FINAL AMPLIFIER TUNING ASSEMBLY. - Located under the front cover of the 18S-3 unit and mounted to the front panel, the final amplifier tuning assembly consists of the final amplifier coils, the final amplifier tuning

capacitors, and the final amplifier band change switch wafers. To remove this assembly for servicing, release the 4 slide fasteners which secure the front cover and remove the front cover, unsolder the two connecting wires, remove the 5 mounting screws which mount the assembly to the front panel, and pull the assembly forward and clear of the 18S-4 unit. When reassembling, be sure and orient the switch coupler sleeve to synchronize the band switch sections. See the NOTE in paragraph 6, b., above.

7. CHANNELING MECHANISM SYNCHRONISM.

a. GENERAL. - Normally the channeling mechanism is properly timed and adjusted at the factory and should require no further attention, except perhaps when it becomes necessary to replace worn parts such as switch wafers, gears, relays, band change motor, etc.

b. PROCEDURE. - The channeling mechanism can be timed and adjusted by the following procedure:

(1) Using some form of auxiliary cable, connect the exciter unit so it can be cycled in the normal fashion outside the 18S-4 unit proper.

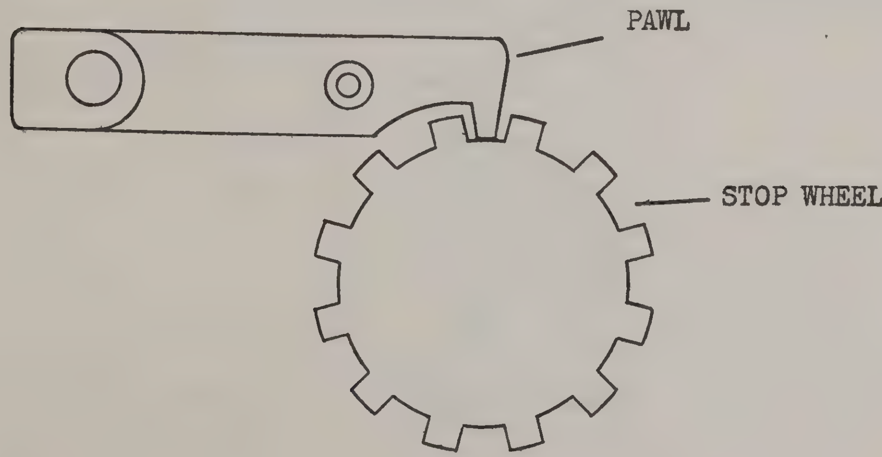
(2) Lay unit right side down with rear end towards operator and apply intermittent voltage if necessary until pawl drops in one of the stop wheel notches. Disconnect power source from unit.

CAUTION

If Step 3 is attempted without first completing Step 2, the full amount of torque needed to loosen the drive gear lock nut may be absorbed by the band change motor seriously damaging the internal gear train.

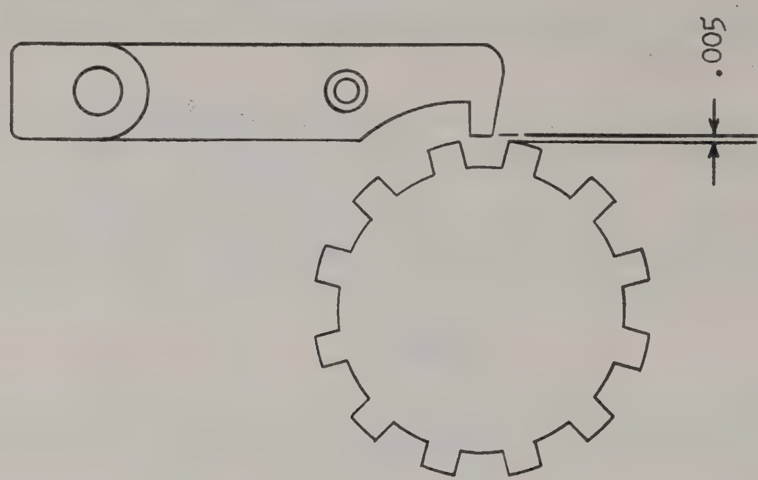
(3) Loosen the drive gear lock nut. A thin type 1/2 in. open end wrench should be used.

(4) Loosen the two mounting screws securing relay K106 to exciter bracket and position relay so that when it is in the unenergized position, the pawl is fully seated in the bottom of the stop wheel notch. Tighten mounting screws securely and liquid stake screw threads.



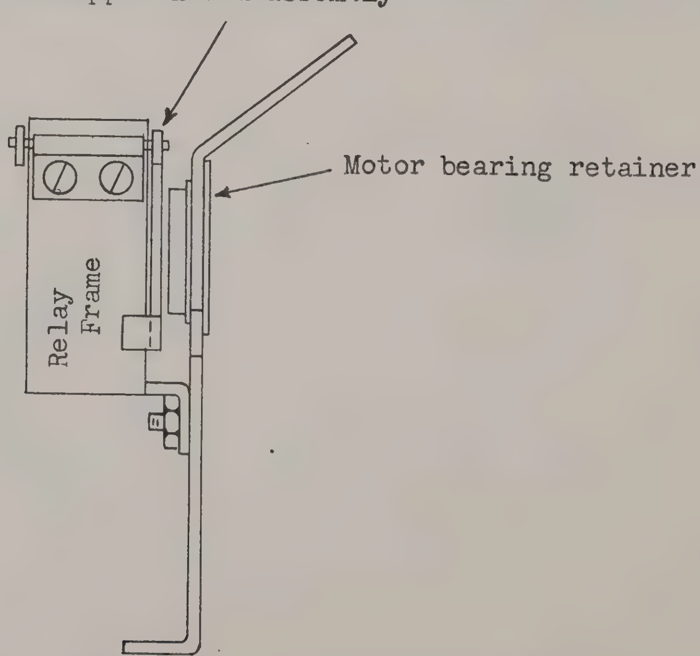
Step 4. - Pawl must be fully seated - relay unenergized.

(5) Loosen the two screws securing the relay clapper and arm assembly to the relay frame and adjust the amount of pawl travel by sliding the assembly away from the relay coil to increase the pawl travel and toward the relay coil to decrease the travel until a clearance of approximately .005 is obtained between the pawl and the O.D. of the stop wheel with the relay in the energized position.



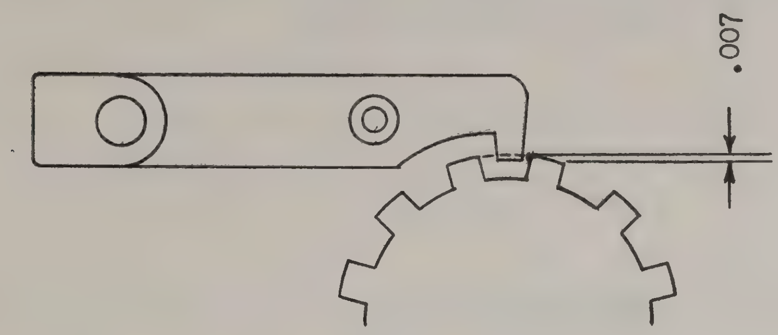
Step 5a. - Adjust pawl travel to clearance shown - relay energized.

Tighten relay mounting screws securely. Care should be taken to see that the relay clapper and arm assembly is mounted straight on relay frame to eliminate possible interference between pawl lifting arm and motor front bearing retainer.



Step 5b. - Keep clapper & arm assembly mounted straight on relay frame to eliminate interference with bearing retainer.

(6) Adjust relay K106 contacts so that upon energizing the relay, contact is made when the pawl is engaged to a depth of approximately .007 in the stop wheel notch.

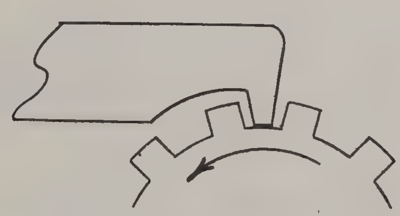


Step 6. - Adjust relay K106 contacts to make when pawl is engaged to depth shown.

This setting is necessary to eliminate the possibility of the motor running while the pawl is resting on the O.D. of the stop wheel. The additional .012 travel of the pawl and lower relay contact will provide the necessary wiping action for self-cleaning of the relay contacts.

(7) Adjust relay K102 contacts to a clearance of .050 to .062.

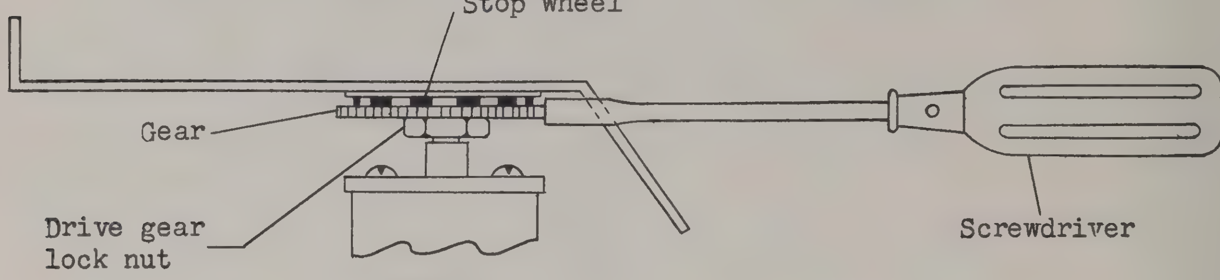
(8) Inch stop wheel around by applying reduced voltage until the pawl drops in a stop wheel notch. Center of pawl should be in center of notch.



Step 8. - Stop wheel with pawl engaged in center of notch.

(9) Insert a flat screwdriver or similar tool having rounded edges between the drive gear teeth and rotate gear in normal direction until the front switch rotor blade is centered in a stator clip. (Any channel.)

(10) Hold gear locked firmly in this position and tighten drive gear lock nut. Unit should be properly timed.

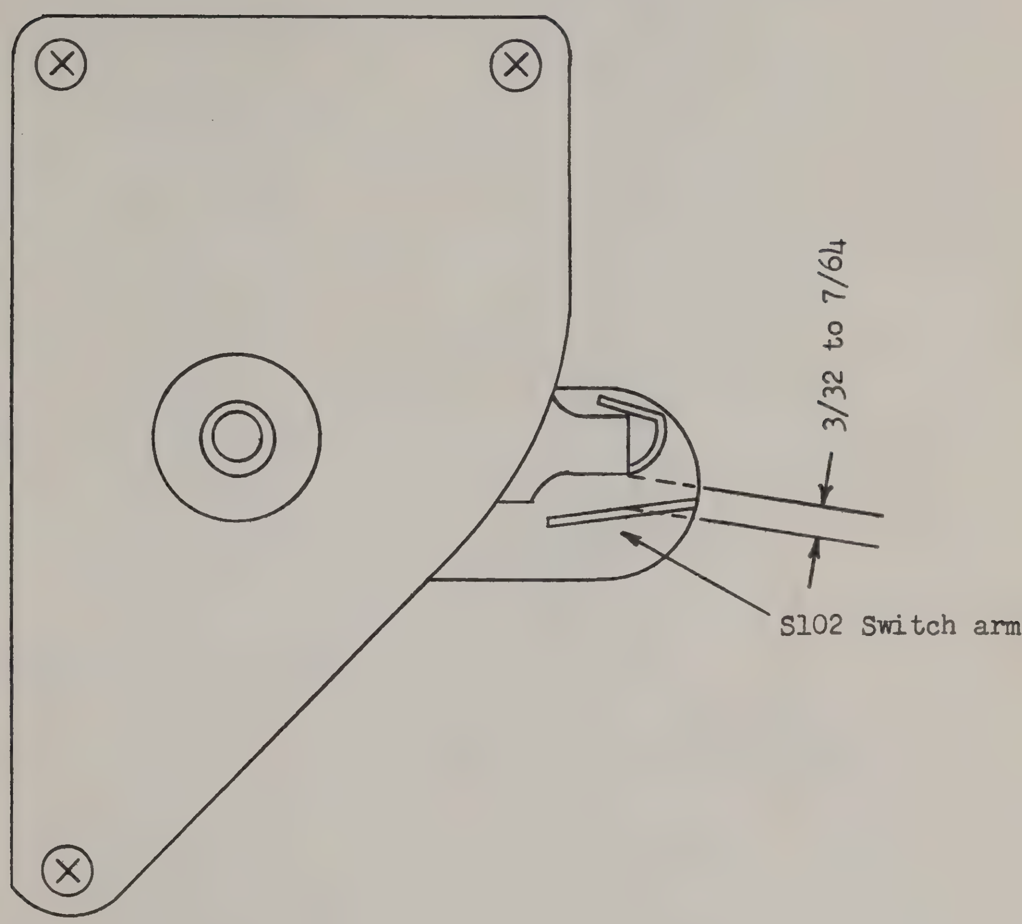


Step 10. - Hold gear with screwdriver and tighten drive gear lock nut.

(11) Check the accuracy of the switch positioning by cycling the unit using a power source of 28 V D.C. Switch rotors should position in stator clips within ± 5 degree of rotor blade centers. Any correction can be made by loosening drive gear lock nut and repeating steps 9 and 10 as needed.

Motor should stop without rotating the motor case when voltages up to 32 V D.C. are used as a primary power source. The torque of the front network assembly will furnish some additional braking for the motor when in actual use.

(12) With motor rear bar assembly resting against the bar stop pin, check clearance between bar and S102 switch arm. This should be 3/32 minimum to 7/64 maximum. Adjustment can be made by loosening the two screws mounting S102 to the rear bracket assembly and positioning as needed. Tighten screws securely and liquid stake screw threads.



Step 12. - Adjust S102 switch arm to clearance shown.

SECTION 6

SUPPLEMENTARY DATA

1. TRANSMITTER COIL NUMBERS VS FREQUENCY.

Coil No.	Part No.	Approx. Tuning Range (MC)
19	503 7272 002	2.0-2.35
1	503 4814 003	2.2-2.6
2	503 4815 003	2.45-2.9
3	503 4816 003	2.7-3.1
4	503 4817 003	2.9-3.5
5	503 4818 003	3.4-4.0
6	503 4819 003	3.5-4.3
7	503 4820 003	4.2-5.2
8	503 4821 003	5.1-6.5
9	503 4822 003	6.3-7.8
10	503 4823 003	7.6-8.2
11	503 4824 003	7.9-9.5
12	503 4825 003	8.5-10.0
13	503 4826 003	9.5-11.0
14	503 4827 003	10.2-12.0
15	503 4828 003	11.5-13.5
16	503 4829 003	12.5-14.0
17	503 7270 002	13.5-16.7
18	503 7271 002	16.0-18.5

2. RECEIVER COIL NUMBERS VS FREQUENCY.

Coil No.	Part No.	Approx. Tuning Range (MC)
12	503 7269 002	2.0-2.8
11	503 7268 002	2.5-3.5
1	503 4830 003	3.25-4.3
2	503 4831 003	3.7-5.0
3	503 4832 003	4.2-5.9
4	503 4833 003	4.5-6.2
5	503 4834 003	5.7-8.2
6	503 4835 003	7.4-10.0
7	503 4836 003	9.0-11.7
8	503 4837 003	11.0-15.5
9	503 4838 003	13.5-17.5
10	503 4839 003	16.5-18.5

NOTE

Two of the above receiver coils (r-f and mixer) are required for each channel.

3. LIST OF TUNING AND LOADING CAPACITORS.

18S POWER AMPLIFIER PLATE TUNING

VALUE MMF	COLLINS PART NUMBER
3	913 0103 00
5	913 0104 00
10	913 0102 00
25	913 4253 20
50	913 4503 20
67	913 4673 20

PA COIL	NO. TURNS	COLLINS PART NUMBER
1, 2, & 4	31	503 6486 001
3	31	504 4557 001
5	24	503 6600 001

180K LOAD COIL TUNING (C501 to C510)

VALUE MMF	COLLINS PART NUMBER	VALUE MMF	COLLINS PART NUMBER
51	937 3019 00	1500	937 3114 00
100	937 3037 00	2000	937 3123 00
150	937 3148 00	2400	937 3129 00
200	937 3057 00	3000	937 3134 00
300	937 3068 00	3600	937 3140 00
510	937 3085 00	4300	937 3145 00
750	937 3096 00	5100	937 3151 00
1000	937 3103 00	6200	937 3156 00

180K loading (C511, C512, C513, C514, C515, C516, C517)

Each capacitor made up of from one to three of the following units:

VALUE MMF	COLLINS PART NUMBER
25	913 4253 20
50	913 4503 20
67	913 4673 20

LICENSING DATA

1. TUBE DATA

	No. and type of tube	Normal Plate Current per tube	Plate Voltage
Osc. Stage	1-12AU6	2.9 ma	300 V
Intermediate Stages	1-6AG7 1-1625	10 ma 33 ma	315 V 475 V
Final Radio Stage	1-813	150 ma	1150 V
Modulator Stage	2-811	100 ma	1150 V

2. CHARACTERISTICS.

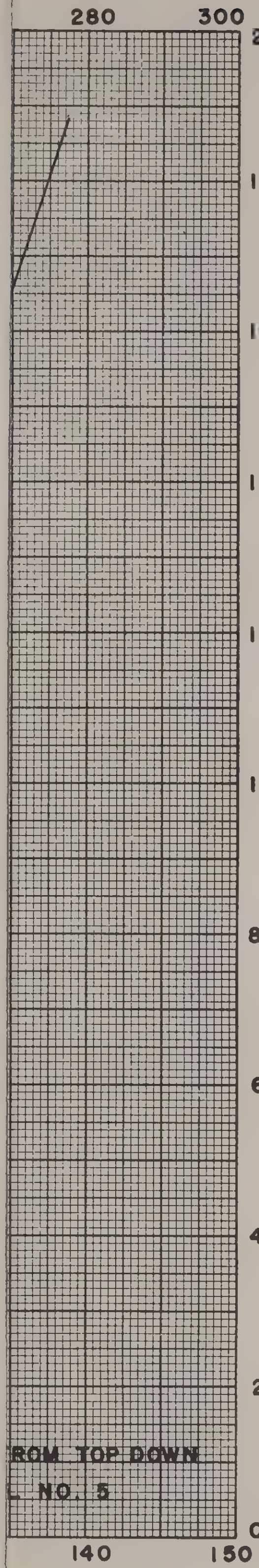
Input Volts - 28 max

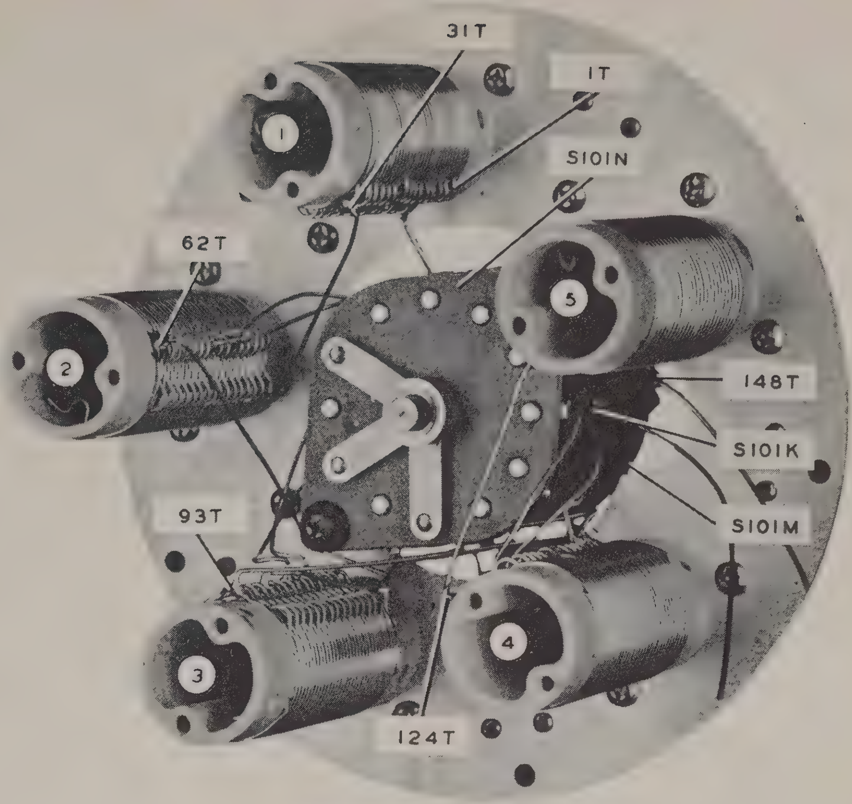
Input current - 38 amps (transmitting)

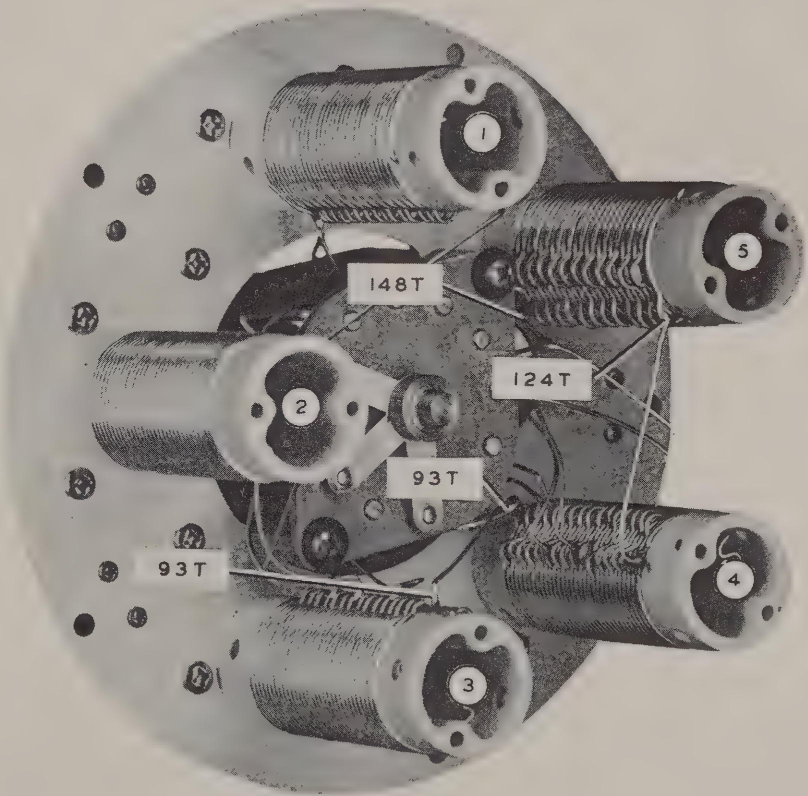
Type Modulation - High level, Class B

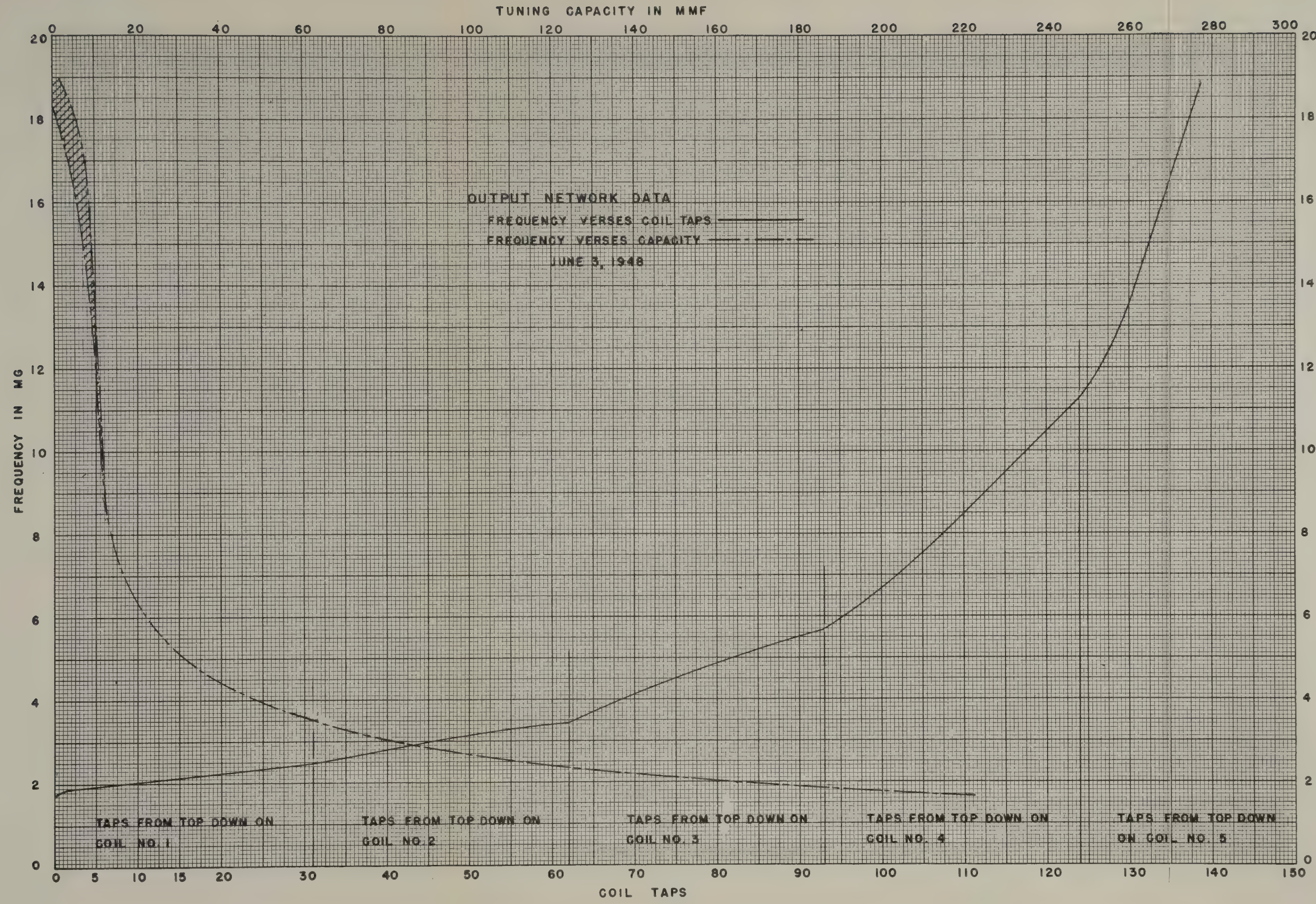
Modulation Percentage - 100%

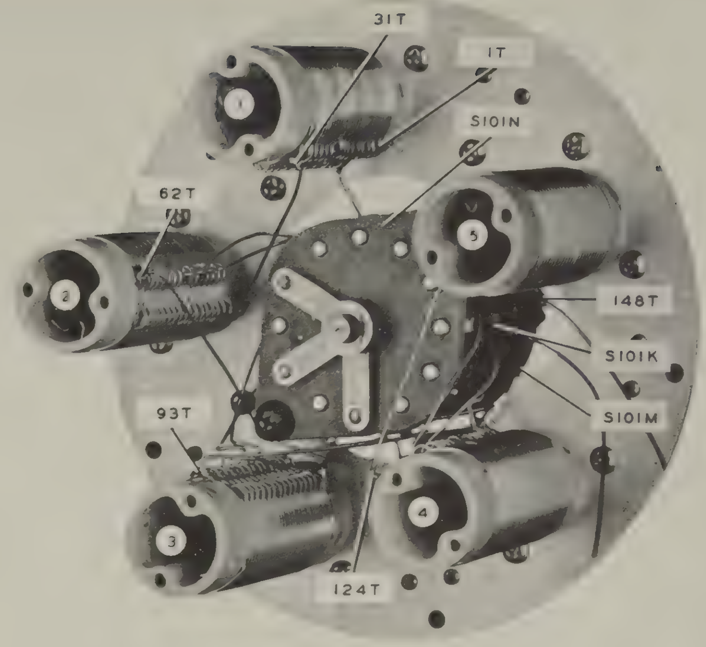
Frequency Deviation - Not more than .01%.

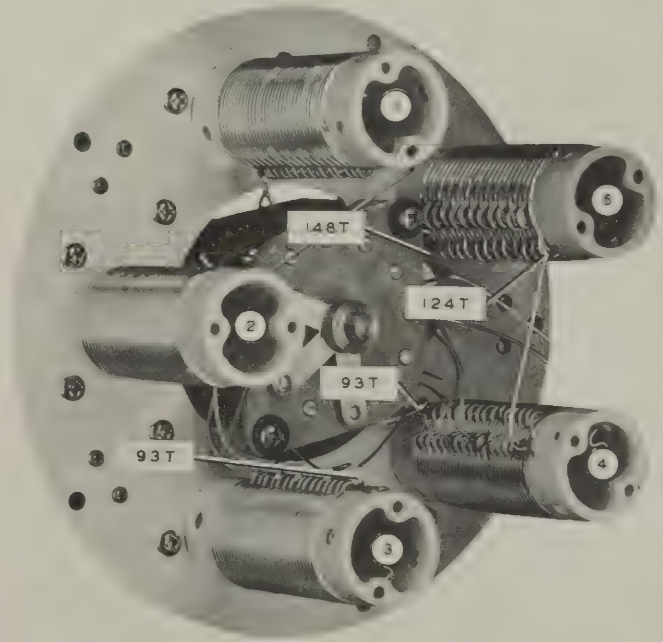

280
300
20
18
16
14
12
10
8
6
4
2
0
ROM TOP DOWN
L NO. 5
140
150


31T
1T
S101N
62T
148T
S101K
93T
S101M
124T


148T
124T
93T
93T







PA PLATE TUNING CHART

PARTS LIST

18S-4 TRANSMITTER-RECEIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
B101	Band Change Motor	MOTOR: Input 24 v DC, built-in gear box	504 5406 002
C101	Receiver plate supply filter and by-pass	CAPACITOR: Dry electrolytic, 10 mf +100 -10%, 50 WV	183 1008 00
C102	V-108 audio coupling	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C103	Diode load filter	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C104	Noise limiter audio coupling	CAPACITOR: Paper, .01 mf ±20%, 100 WV	931 0003 00
C105	Noise limiter audio filter	CAPACITOR: Paper, 0.1 mf ± 20%, 150 WV	931 0239 00
C106	V-106 Screen by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C107	V-106 Cathode by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C108	V-105 plate decoupling	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C109	Detector return by-pass	CAPACITOR: Paper, .05 mf ±20%, 150 WV	931 0238 00
C110	V-105 grid coupling	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C111		CAPACITOR: Not used	
C112	V-104 Cathode by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C113	AVC time constant and decoupling	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C114	V-104 grid coupling	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C115	V-103 screen by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C116	V-103 cathode by-pass	CAPACITOR: Mica, 220 mmf ±20%, 500 WV	935 0121 00
C117	V-103 grid coupling	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C118	V-102 grid coupling	CAPACITOR: Ceramic, 30 mmf ±5%, 500 WV	916 4438 00
C119	V-102 screen by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C120	V-102 plate decoupling	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C121	V-101 cathode feedback	CAPACITOR: Ceramic, 47 mmf ±2%, 500 WV	916 4361 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C122	V-101 grid feed-back	CAPACITOR: Ceramic, 47 mmf ±2%, 500 WV	916 4361 00
C123	AVC i-f coupling	CAPACITOR: Mica 100 mmf ±20%, 500 WV	935 0107 00
C124	AVC decoupling	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C125	Mixer coil tuning	CAPACITOR: Mica 360 mmf ±5%, 500 WV	935 0129 00
C126	Antenna coupling	CAPACITOR: Ceramic, 20 mmf ±5%, 500 WV	916 4420 00
C127	Antenna coupling	CAPACITOR: Mica, 220 mmf ±20%, 500 WV	935 0121 00
C128	V-109 grid return by-pass	CAPACITOR: Dry electrolytic, 10 mf +100 -10%, 50 WV	183 1008 00
C129	V-102 cathode by-pass	CAPACITOR: mica, 100 mmf ±20%, 500 WV	935 0107 00
C130	Z-104 output by-pass	CAPACITOR: Ceramic, 1 mmf ±1/2 mmf, 500 WV	916 4369 00
C131	V-104 screen by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C132	V-108 grid filter	CAPACITOR: Mica, 470 mmf ±10%, 500 WV	935 0134 00
C133	V-108 plate filter	CAPACITOR: Mica, 3300 mmf ±10%, 500 WV	935 4074 00
C134	Motor noise filter	CAPACITOR: Paper, 0.1 mf ±20%, 150 WV	931 0239 00
C135	Decoupling	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C136	BFO coupling	CAPACITOR: Dry electrolytic, 20 mf, 150WV	184 6509 00
C137	Feedback	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C138	Injection coupling	CAPACITOR: Mica, 330 mmf ±10%, 500 WV	935 0127 00
C139	Sidetone tuning	CAPACITOR: Paper, .01 mf ±20%, 150 WV	931 0236 00
C140	Sidetone feed-back	CAPACITOR: Mica, 6800 mmf ±20%, 300 WV	935 2111 00
C141	Band change time delay	CAPACITOR: Dry electrolytic, 50 mf, 50 WV	184 6523 00
C142	HF osc coupling	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C143	Mixer grid tank	CAPACITOR: Ceramic, 5 mmf ±1/2 mmf,500 WV	916 4385 00
C144	V-101 plate by-pass	CAPACITOR: Paper, .1 mf ±10%, 150 WV Alt.	931 0333 00 931 0239 00
C203	V-201 screen by-pass	CAPACITOR: Mica, .002 mf ±20%, 750 WV	915 2205 40

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C205	V-201 plate blocking	CAPACITOR: Mica, .002 mf ±20%, 750 WV	915 2205 40
C206	V-202 grid decoupling	CAPACITOR: Mica, .0005 mf ±10%, 750 WV	915 3505 20
C207	V-202 filament by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C208	V-202 filament by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C209	V-202 plate coupling	CAPACITOR: Mica, 2000 mmf ±20%, 3500 WV	975 0001 00
C212	High voltage ripple filter	CAPACITOR: Paper, 2 mf ±20%, 1500 WV	930 3524 00
C214	Low voltage ripple filter	CAPACITOR: Paper, 2 mf +40 -15%, 600 WV	930 0023 00
C215	Dynamotor noise filter	CAPACITOR: Paper, .1 mf ±10%, 600 WV	956 2012 20
C216	Dynamotor noise filter	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C217	Dynamotor noise filter	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C218	V-203 Cathode by-pass	CAPACITOR: Dry electrolytic, 10 mf +100 -10%, 50 WV	183 1008 00
C219	V-203 plate and screen decoupling	CAPACITOR: Paper, 2 mf +40 -15%, 600 WV	930 0023 00
C220	Noise filter	CAPACITOR ASSEM: two pem fasteners w/ CAPACITOR: Paper, 1.3 mf ±20%, 50 WV	520 3706 00 930 0004 00
C221	Noise filter	CAPACITOR ASSEM: two pem fasteners w/ CAPACITOR: Paper, 1.3 mf ±20%, 50 WV	520 3706 00 930 0004 00
C222	Network capacitor	CAPACITOR: Mica, 220 mmf ±20%, 2500 WV	936 0206 00
C223	V-203 plate filter	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C224	V-204 audio connection	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C225	V-205 audio connection	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C226A	V-202 Plate blocking	CAPACITOR: Mica, .002 mf ±20%, 2500 WV	950 2203 40
C226B	V-202 Plate blocking	CAPACITOR: Mica, .002 mf ±20%, 2500 WV	950 2203 40

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C227	V-202 filament by-pass	CAPACITOR: Mica, 2200 mmf ±20%, 500 WV	935 4068 00
C228	V-206 grid coupling	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C229	V-207 Cathode by-pass	CAPACITOR: Mica, 100 mmf ±20%, 500 WV	935 0107 00
C230	V-206 Cathode by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C231	V-206 screen by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C232	V-201 grid coupling	CAPACITOR: Mica, 220 mmf ±20%, 500 WV	935 0121 00
C235	V-201 cathode by-pass	CAPACITOR: Mica, 10,000 mmf ±20%, 300 WV	935 5009 00
C236	V-207 feedback	CAPACITOR: Ceramic, 15 mmf ±5%, 500 WV	916 4412 00
C237	V-202 filament by-pass	CAPACITOR: Mica, .002 mf ±10%, 1200 WV	925 2205 00
C240	Spark filter	CAPACITOR: Paper, .05 mf ±20%, 400 WV	930 0086 00
C241		CAPACITOR: 2000 mmf ±20%, 3500 WV	975 0001 00
CR203	K-203 surge shorting	RECTIFIER: Selenium, 1.5 ma DC	353 0008 00 alt 353 0002 00
D201	Transmitter plate supply	DYNAMOTOR ASSEM: DYNAMOTOR: Dual voltage output; Input; 27 v DC; 32 amp; Output #1: 400 v DC, 0.75 amp; Output #2: 750 v DC, 0.35 amp	503 4793 003 231 0031 00 alt 504 5041 004 231 0004 00
E201		BOARD TERMINAL: Bakelite, 4 term	367 4040 00
I101	K-102 surge preventing	BULB: Neon, for use on voltages above 90 v DC or 65 v AC, 1/25 w	262 0025 00
J101		Not used	
J102		Not used	
J103	Exciter unit power connector	RECEPTACLE: 26 term, midget eyelets	504 4678 001
J104	B-101 power	CONNECTOR: Motor	503 0919 001
J105	Transmission line connector	RECEPTACLE: 1" x 1" x 1-1/16"	357 9005 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
J106	Panel phone jack	JACK: Phone, midget, for two cond plug	358 1080 00
J107	Panel microphone jack	JACK: Phone, midget, 3 circ	358 1100 00
K101	Microphone	RELAY: Circ control, coil 100 ohm ±10%, 26.5 v DC	410 0027 00
K102	B-101 motor reversing	RELAY: Motor reverse, DPDT AND 1PNO	410 0027 00
K103	Receiver crystal selector	RELAY: Crystal selector and microphone ck't, SPDT	410 0059 00
K104	Transmitter crystal selector	RELAY: Crystal selector and microphone ck't, SPDT	410 0059 00
K105	Delay relay	RELAY: Band change delay	410 0059 00
K106	Auto positioner pawl relay	RELAY: Auto positioner	503 5115 003
K201	Dynamotor control solenoid	RELAY: Power, SPNO, 28 v 80 ohm ±10%	401 7900 00
K202	Filament control	RELAY: Filament, 1PNO, double break, 28v	405 2202 00
K203	Antenna change	RELAY: Circuit control, 28 v DC, 185 ohm ±10%	410 0072 00
L101	Receiver oscillator cathode choke	COIL: RF choke, 3 section, 220 uh	240 0037 00
L102	Receiver plate filter choke	COIL: Filter choke, 0.85 hy, 100 ohm max, 10 v rms, 120 cps, 1500 TV	678 0035 00
L103	V-101 plate choke	COIL: RF choke, 34 uh, 100 ma	240 0010 00
L104	BFO cathode choke	COIL: RF choke, 1 mh +20 -10%, 3 pi	240 0047 00
L105	Static drain choke	COIL: RF choke, 2.5 mh ±10%, 50 ohm	240 5300 00
L106	BFO Plate tuning	COIL: OSC, #41 EN Litz wire	503 2416 001
L200	V-206 plate choke	COIL: RF choke, 39T #32 HE	503 6559 002
L201	V-201 plate choke	COIL: RF choke, 2.5 mf ±10%, 50 ohm	240 5300 00
L202	V-202 grid choke	COIL: RF choke, 2.5 mf ±10%, 50 ohm	240 5300 00
L203	V-202 plate choke	COIL: RF choke, 150 uh ±5%	503 6482 001
L204	Static drain	COIL: RF choke, 2.5 mh ±10%, 50 ohm	240 5300 00
L205	Dynamotor noise filter	COIL: RF choke, multiple pi, duo-lateral wound	240 5800 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
L206	Dynamotor noise filter	COIL: RF choke, multiple pi, duo-lateral wound	240 5800 00
L207	Dynamotor noise filter	COIL: RF choke, multiple pi, duo-lateral wound	240 5800 00
L208	Noise filter	COIL: RF choke, 10 wind. high c.	520 4028 00
L209	V-207 Cathode	COIL: RF choke, 1 mh +20 -10%, 3 pi	240 0047 00
L210	V-207 plate	COIL: RF choke, 39 T #32 HE	503 6558 002
M201	Plate and grid current and battery volt meter	METER: 2 ma DC	458 0164 00
P101	Power	CONNECTOR: Pin insert, 32 cont	370 2016 00
P102	Power	CONNECTOR: Pin insert, 32 cont	370 2016 00
P103	Exciter power	CONNECTOR: 26 term midget banana plugs	520 3032 00
P104	B-101 power	CONNECTOR: Motor	504 4975 002
R101		RESISTOR: Not used	
R102	V-108 grid	RESISTOR: 22,000 ohm ±10%, 1/2 w	745 1142 00
R103	V-108 grid	RESISTOR: .33 megohm ±10%, 1/2 w	745 1191 00
R104	AVC diode load resistor	RESISTOR: .12 megohm ±10%, 1/2 w	745 1174 00
R105	Noise limiter filter	RESISTOR: .22 megohm ±10%, 1/2 w	745 1184 00
R106	Noise limiter filter	RESISTOR: .22 megohm ±10%, 1/2 w	745 1184 00
R107	Delay bias voltage divider	RESISTOR: 180,000 ohm ±10%, 1/2 w	745 1181 00
R108	Delay bias voltage	RESISTOR: .18 megohm ±10%, 1/2 w	745 1181 00
R109	Noise limiter decoupling	RESISTOR: .22 megohm ±10%, 1/2 w	745 1184 00
R110	AVC load	RESISTOR: .68 megohm ±10%, 1/2 w	745 1205 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R111	AVC Voltage divider	RESISTOR: .47 megohm ±10%, 1/2 w	745 1198 00
R112	AVC decoupling	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R113	Delay bleeder	RESISTOR: .33 megohm ±10%, 1/2 w	745 1191 00
R114	V-106 plate decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R115	V-106 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R116	V-105 plate decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R117	V-105 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R118	V-105 grid	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R119	V-104 plate decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R120	V-101 plate decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R121	Voltage divider	RESISTOR: 22,000 ohm ±10%, 1/2 w	745 1142 00
R122	V-104 grid	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R123	V-103 plate decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R124	V-103 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R125	V-103 grid	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R126	V-102 grid	RESISTOR: 56,000 ohm ±10%, 1/2 w	745 1160 00
R127	V-102 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R128	V-102 screen decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R129	V-102 plate decoupling	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R130	V-101 grid return and bias resistor	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R131	V-109 bias resistor	RESISTOR: 180 ohm ±10%, 1/2 w	745 1055 00
R132	Voltage divider for Y-102	RESISTOR: 1 megohm ±10%, 1/2 w	745 1212 00
R133	Voltage divider for Y-102	RESISTOR: 22,000 ohm ±10%, 1/2 w	745 1142 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R134		RESISTOR: Not used	
R135	V-110 cathode	RESISTOR: 1000 ohm ±10%, 1/2 w	745 1086 00
R136	Automatic bias	RESISTOR: .27 megohm ±10%, 1/2 w	745 1188 00
R137	V-103 Inj grid return	RESISTOR: 22,000 ohm ±10%, 1/2 w	745 1142 00
R138	Filament dropping resistor	RESISTOR: 20 ohm ±10%, 10 w	710 1202 00
R139	Sidetone oscillator plate series	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R140	Sidetone oscillator plate	RESISTOR: 33,000 ohm ±10%, 1/2 w	745 1149 00
R141	V-108 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R142	Audio dropping	RESISTOR: .18 megohm ±10%, 1/2 w	745 1181 00
R143	V-109 grid	RESISTOR: .22 megohm ±10%, 1/2 w	745 1184 00
R144	Delay capacitor discharge	RESISTOR: 470 ohm ±20%, 1/2 w	745 1073 00
R145		RESISTOR: 3 ohm ±10%, 10 w	710 1320 00
R201	V-201 cathode	RESISTOR: 150 ohm ±20%, 10 w	710 0019 00
R202	V-201 grid	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R203	V-201 screen voltage dropping	RESISTOR: 25,000 ohm ±10%, 10 w size	710 1254 20
R204	V-202 grid	RESISTOR: 20,000 ohm ±10%, 10 w	710 1204 20
R205	V-202 grid current	RESISTOR: 506 ohm ±1%, 1 w	722 0028 00
R206	V-202 parasitic suppressor	RESISTOR: 47 ohm ±10%, 2 w	745 5030 00
R207	Battery voltage meter	RESISTOR: 23,000 ohm ±1%, 1 w	722 0029 00
R208	M-201 meter multiplier	RESISTOR: 4000 ohm ±2%, 1 w	721 3447 00
R209	PA plate current meter shunt	RESISTOR: 27.2 ohm ±5%, 5 w	747 9027 00
R210	V-203 cathode	RESISTOR: 220 ohm ±10%, 1 w	745 3058 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R211	V-206 plate & screen	RESISTOR: 10,000 ohm ±10%, 10 w size	710 1104 20
R212	Microphone dropping	RESISTOR: 470 ohm ±10%, 2 w	745 5072 00
R213	Filament equalizing	RESISTOR: 12.6 ohm ±5%, 20 w	710 0044 00
R214	V-203 plate decoupling	RESISTOR: 3000 ohm ±10%, 10 w size	710 1342 00
R215	V-203 grid loading	RESISTOR: 68,000 ohm ±10%, 1/2 w	745 1163 00
R216	V-203 grid stabilizing	RESISTOR: 56,000 ohm ±10%, 1/2 w	745 1160 00
R217	V-207 filament dropping	RESISTOR: 100 ohm ±10%, 10 w	710 1100 20
R218	External meter multiplier	RESISTOR: 4000 ohm ±2%, 1 w	721 3447 00
R219	V-206 grid	RESISTOR: .27 megohm ±10%, 1/2 w	745 1188 00
R220	V-207 plate	RESISTOR: 270 ohm ±10%, 1/2 w	745 1062 00
R221	V-207 screen voltage divider	RESISTOR: 33,000 ohm ±10%, 1 w	745 3149 00
R222	V-207 grid	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R223	V-206 screen	RESISTOR: 22,000 ohm ±10%, 2 w	745 5142 00
R224	V-206 plate	RESISTOR: 82 ohm ±10%, 1/2 w	745 1041 00
R225	V-206 cathode	RESISTOR: 82 ohm ±10%, 1/2 w	745 1041 00
R226	Filament dropping	RESISTOR: 2.2 ohm ±10%, 25 w	710 0401 00
R227	Filament dropping	RESISTOR: 2.2 ohm ±10%, 25 w	710 0401 00
R228	Filament equalizing	RESISTOR: 100 ohm ±10%, 10 w	710 1100 20
R229	V-207 plate dropping	RESISTOR: 18,000 ohm ±5%, 10 w	710 0257 00
R230	V-207 screen	RESISTOR: 22,000 ohm ±10%, 2 w	745 5142 00
R240	Spark filter	RESISTOR: 47 ohm ±10%, 1/2 w	745 1030 00
R241	Time delay series	RESISTOR: 82 ohm ±10%, 1/2 w	745 1041 00
R242		RESISTOR: 47 ohm ±10%, 2 w	745 5030 00
S101A	Receiver crystal selector Section A	SWITCH: Section, 1 circuit, shorting, 12 pos	269 1247 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
S101B	Receiver mixer coil selector	SWITCH: Section, 2 cir, 12 pos	269 1093 00
S101C	Receiver crystal selector Section B	SWITCH: Section, 1 circ, shorting, 12 pos	269 1247 00
S101D	Receiver r-f coil selector	SWITCH: Section, 2 circ, 12 pos	269 1093 00
S101E	Buffer-doubler coil selector	SWITCH: Section, 2 circ, 12 pos	269 1094 00
S101F	Transmitter osc coil selector	SWITCH: Section, 1 circuit, shorting 12 pos	269 1247 00
S101G	Secondary circuit seeker	SWITCH: Section, 1 circ, non-shorting, 12 pos	269 1277 00
S101H	Primary circuit seeker	SWITCH: 1 circ, 10 pos, shorting	269 1268 00
S101J	Transmitter crystal selector Sec. B.	SWITCH: Section, 1 circ, shorting, 12 pos	269 1247 00
S101K	PA tank coil selector	SWITCH: Middle stator plate	503 6539 002
S101M	PA tank capacitor	SWITCH: Front stator plate	503 6536 002
S101N	PA tank shorting	SWITCH: Rear stator plate	503 6537 002
S102	Band Change Motor grounding	SWITCH: Micro snap, SPDT, 28.5 v DC,6 amp	260 0025 00
S201	Meter circuit selector	SWITCH: 2 circuit, 3 pos, non-shorting	259 1391 00
T101	Receiver audio output	TRANSFORMER: Audio, Pri: 6000 ohm CT, 500TV, Sec: 600 ohm, 500 TV, 100-400 cps	677 0146 00
T102	Receiver interstage audio transformer	TRANSFORMER: Audio Interstage, Pri: 1000 ohm DC max, 0.2 ma unbal, 500 TV, Sec: CT, 500 TV, 100-400 cps	677 0144 00
T201	Modulation transformer	TRANSFORMER, Mod, Pri; 15,000 ohm CT, 150 ma, Sec #1: 7300 ohm 4250 TV, Sec #2: 970 ohm, 2500 TV, 300-4000 cps	677 0002 00
T202	Modulator driver transformer	TRANSFORMER, Mod, Driver, Pri: 5000 ohm 30 ma, 300-4000 cps, Sec #1: 1000 ohm, Sec #2: 1000 ohm, 3 w	677 2530 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
T203	Microphone transformer	TRANSFORMER: Microphone, Pri: 75 ohm,Sec: 125,000 ohm, 100-5000 cps, 1000 TV, .02 w	677 2590 00
T204	Sidetone oscillator	TRANSFORMER: Audio output, Pri: 60 ma unbal, 6000 ohm CT, 1000 TV, SEC: 500 ohm, 1000 TV	667 0025 00
V101	Receiver high frequency oscillator	TUBE: type 28D7; twin beam	255 0168 00
V102	Receiver radio frequency amplifier	TUBE: type 6BA6; pentode	255 0185 00
V103	Receiver mixer	TUBE: type 12BE6; pentagrid converter	257 0042 00
V104	Receiver first i-f amplifier	TUBE: type 6BA6; pentode	255 0185 00
V105	Receiver second i-f amplifier	TUBE: type 6BA6; pentode	255 0185 00
V106	Receiver third i-f amplifier	TUBE: type 6BA6; pentode	255 0185 00
V107	Receiver noise limiter and AVC tube	TUBE: type 12AL5; twin diode	255 0197 00
V108	Receiver audio driver	TUBE: Type 12AU7; twin triode	255 0199 00
V109	Receiver audio power amplifier	TUBE: type 28D7; twin beam	255 0168 00
V110	Beat frequency oscillator	TUBE: type 12AU7; twin triode	255 0199 00
V201	Transmitter oscillator	TUBE: type 1625; beam	256 0057 00
V202	Power amplifier	TUBE: type 813; beam	256 0054 00
V203	Transmitter audio driver	TUBE: type 6V6; pentode	255 0090 00
V204	Transmitter modulator	TUBE: type 811; triode	256 0053 00
V205	Transmitter modulator	TUBE: type 811; triode	256 0053 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
V206	Isolation Amp.	TUBE: type 6AG7, pentode	255 0039 00
V207	Transmitter oscillator	TUBE: type 12AU6; pentode	255 0198 00
XI101	Mtg. for I-101	SOCKET: mtg for neon lamp	265 1006 00
XV101	Socket for V-101	SOCKET: bakelite, loctal 7 pin	220 1002 00
XV102 XV103 XV104 XV105 XV106 XV107	Socket for V-102, V-103, V-104, V-105, V-106, V-107	SOCKET: 7 pin miniature	220 1034 00
XV108	Socket for V-108	SOCKET: 9 pin miniature	220 1063 00
XV109	Socket for V-109	SOCKET: bakelite, loctal 7 pin	220 1002 00
XV110	Socket for V-110	SOCKET: 9 pin miniature	220 1063 00
XV201	Socket for V-201	SOCKET: 7 term ceramic	220 1006 00
XV202	Socket for V-202	SOCKET: wafer, 7 cont "Jumbo"	220 5711 00
XV203	Socket for V-203	SOCKET: octal, mica filled bakelite	220 1005 00
XV204 XV205	Sockets for V-204, V-205	SOCKET: 4 term low-loss ceramic	220 5450 00
XV206	Socket for V-206	SOCKET: octal, mica filled bakelite	220 1005 00
XV207	Socket for V-207	SOCKET: 7 pin miniature	220 1034 00
Y101	Receiver second detector	CRYSTAL DIODE: germanium, peak inverse anode voltage 85 v	353 0028 00
Y102	Receiver anti-blocking rectifier	CRYSTAL DIODE: germanium, peak inverse anode voltage 85 v	353 0028 00
Z101	First stage i-f transformer	TRANSFORMER: IF, 455 kc, two 75 mmf $\pm 3\%$ mica capacitors	502 9929 001
Z102	Second stage i-f transformer	TRANSFORMER: IF, 455 kc, two 75 mmf $\pm 3\%$ mica capacitors	502 9929 001
Z103	Third stage i-f transformer	TRANSFORMER: IF, 455 kc, two 75 mmf $\pm 3\%$ mica capacitors	502 9929 001
Z104	I-F output transformer	TRANSFORMER: IF, 455 kc, two 75 mmf $\pm 3\%$ mica capacitors	502 9929 001

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
B502	Autotune motor	MOTOR AND GEAR ASSEM: DC, shunt wound 26.5 v, 0.03 hp at 6000 rpm	502 7601 002
		MOTOR LESS GEAR:	502 7547 004
C501	thru C510 tuning capacitors to be chosen from the following:		
	Antenna loading capacitors	CAPACITOR: 51 mmf ±5%, 2500 WV	937 3019 00
		CAPACITOR: 100 mmf ±5%, 2500 WV	937 3037 00
		CAPACITOR: 150 mmf ±5%, 2500 WV	937 3048 00
		CAPACITOR: 200 mmf ±5%, 2500 WV	937 3057 00
		CAPACITOR: 300 mmf ±5%, 2500 WV	937 3068 00
		CAPACITOR: 510 mmf ±5%, 2500 WV	937 3085 00
		CAPACITOR: 750 mmf ±5%, 2500 WV	937 3096 00
		CAPACITOR: 1000 mmf ±5%, 2500 WV	937 3103 00
		CAPACITOR: 1500 mmf ±5%, 2500 WV	937 3114 00
		CAPACITOR: 2000 mmf ±5%, 2500 WV	937 3123 00
		CAPACITOR: 2400 mmf ±5%, 2500 WV	937 3129 00
		CAPACITOR: 3000 mmf ±5%, 2500 WV	937 3134 00
		CAPACITOR: 3600 mmf ±5%, 2500 WV	937 3140 00
		CAPACITOR: 4300 mmf ±5%, 2500 WV	937 3145 00
		CAPACITOR: 5100 mmf ±5%, 2500 WV	937 3151 00
		CAPACITOR: 6200 mmf ±5%, 2500 WV	937 3156 00
C511	thru C517 capacitors to be chosen from the following:		
		CAPACITOR: 25 mmf ±10%, 2500 WV RMS @ 2 MC	913 4253 20
		CAPACITOR: 50 mmf ±10%, 2500 WV RMS @ 2 MC	913 4503 20
		CAPACITOR: 67 mmf ±10%, 2500 WV RMS @ 2 MC	913 4673 20
C518	SWR bridge	CAPACITOR: 220 mmf ±20%, 500 WV	935 0121 00
C519	SWR bridge	CAPACITOR: 220 mmf ±20%, 500 WV	935 0121 00
C520	SWR bridge	CAPACITOR: 68 mmf ±20%, 500 WV	935 0100 00
C521	SWR bridge	CAPACITOR: 10 mmf ±20%, 500 WV	935 0071 00
C522	SWR filter	CAPACITOR: 1500 mmf ±20%, 350 WV	913 0393 00
C523	SWR meter filter	CAPACITOR: 0.001 mf ±20%, 500 WV	935 4101 00
C524	Plate current filter	CAPACITOR: 0.001 mf ±20%, 500 WV	935 4101 00
C525	Motor noise filter	CAPACITOR: 0.1 mf ±20%, 600 WV	930 0011 00
CR501	SWR rectifier	CRYSTAL UNIT: rectifying, 0-300 mc	353 0028 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
J501	Input receptacle	RECEPTACLE: 1" x 1" x 1-1/16"	357 9005 00
J502	Antenna connector	PLUG: Antenna connect	503 4765 001
J503	Power connector	RECEPTACLE: 16 term wall mtg	371 3060 00
J504	Autotune power conn	BOARD ASSEM: 15 term	502 8296 002
K501	Motor control	RELAY: Special, 26.5 v DC, IF with 1B1A external	502 7600 004
L501	Variometer	COIL: Solid copper single conductor magnet wire, #10 AWG	571 0380 40
L502	HF tuning	COIL: Tinned round copper wire #16 AWG	503 6272 001
L503	Loading	COIL: 21 turns #10 copper wire, tapped at ninth turn from base	504 4261 002
L504	Static drain choke	COIL: RF Choke Assem, 150 uh ±5%, 145 turns #26 SE wire	503 6482 001
L505	RF choke	COIL: RF choke, 1 mh +20 -10%	240 0047 00
L506	RF choke	COIL: RF choke, 8.2 mh ±10% @ 1000 cps	240 0046 00
M501	Standing wave indicator	METER: 2 ma DC	458 0164 00
M502	Plate current	METER: 2 ma DC	458 0164 00
P501	Coaxial line	PLUG: cable connector	357 9006 00
P502	Antenna conn plug	JACK: Antenna lead-in	503 4766 001
P503	Power and control	PLUG: 16 term cable mtg	371 0012 00
P504	Autotune power	CONNECTOR: autotune power, 15 term	502 7613 002
R501 R502 R503 R504 R505 R506 R507 R508 R509 R510	SWR bridge	RESISTOR: 10 ohm ±10%, 1 w	745 3002 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R511	SWR meter multiplier	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R512	SWR sensitivity control	RESISTOR: 10,000 ohm ±20%, 1/4 w	376 3507 00
S501A	Input capacitor sel. switch	SWITCH PLATE ASSEM: SWITCH ARM ASSEM: COLLECTOR RING ASSEM:	504 4265 002 504 4258 002 504 4264 002
S501B	Parallel capacitor grounding switch	SWITCH PLATE ASSEM: SWITCH ARM ASSEM: COLLECTOR ASSEM:	504 4247 002 502 9879 002 504 4262 002
S501C	Output capacitor selecting switch	SWITCH PLATE ASSEM: SWITCH ARM ASSEM: SWITCH PLATE ASSEM:	504 4247 002 504 4255 002 504 4242 002
S501D	Loading coil selector switch	SWITCH PLATE ASSEM: SWITCH ARM ASSEM: SWITCH PLATE ASSEM:	504 4247 002 504 4253 002 504 4242 002
S501E	Series capacitor switch	SWITCH PLATE ASSEM: SWITCH ARM ASSEM: SWITCH COLLECTOR PLATE ASSEM:	504 4244 002 504 4251 002 504 4248 002
S502	Test switch	SWITCH: DPDT, toggle	266 0002 00
S503	Seeking Switch	SWITCH: autotune seeking, 1 circ, 10 pos 1 desk	502 5204 003
S504	Limit switch	SWITCH: part of K501	

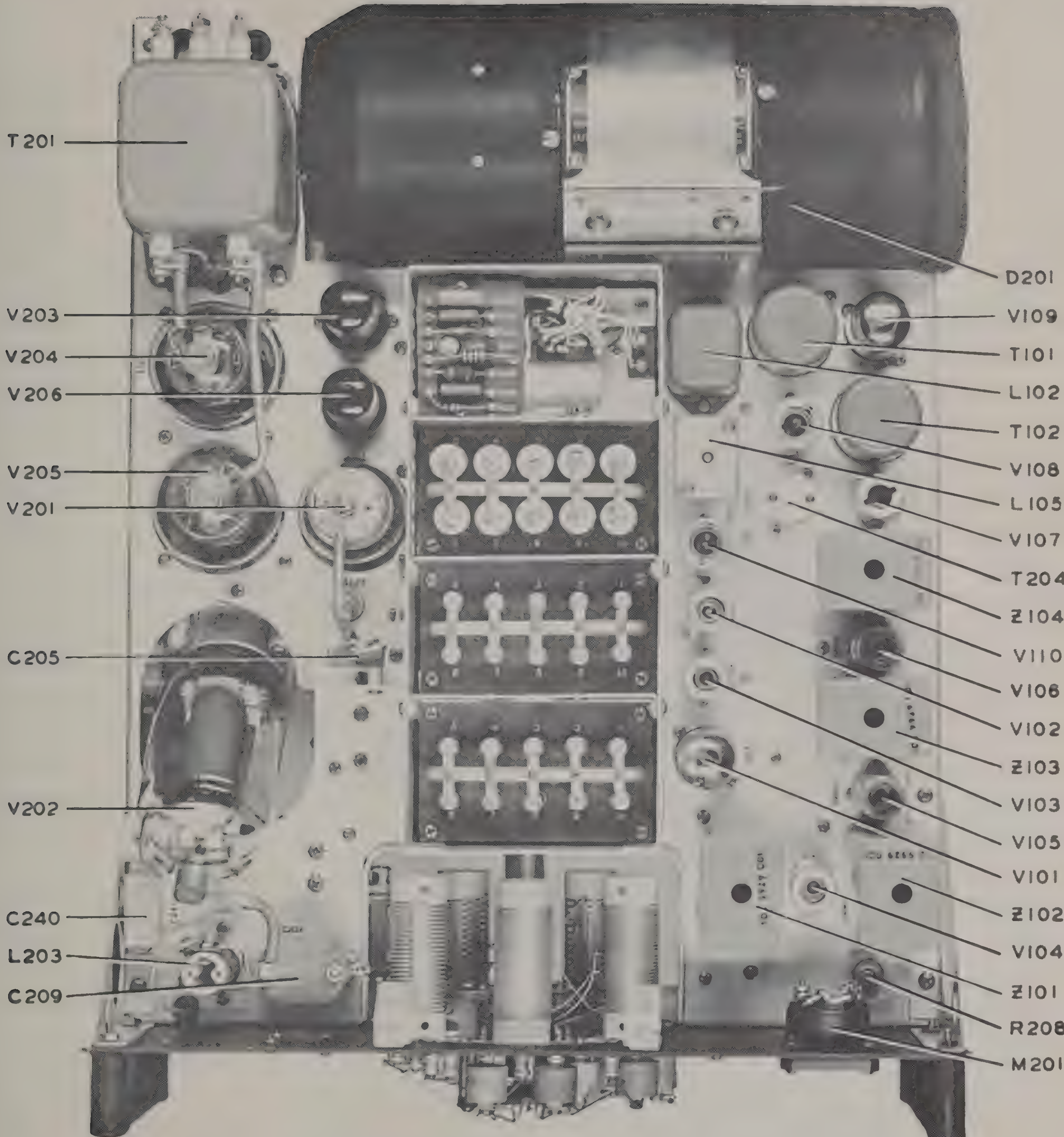


FIGURE 8-1 MODEL 18S-[redacted] TOP OPEN

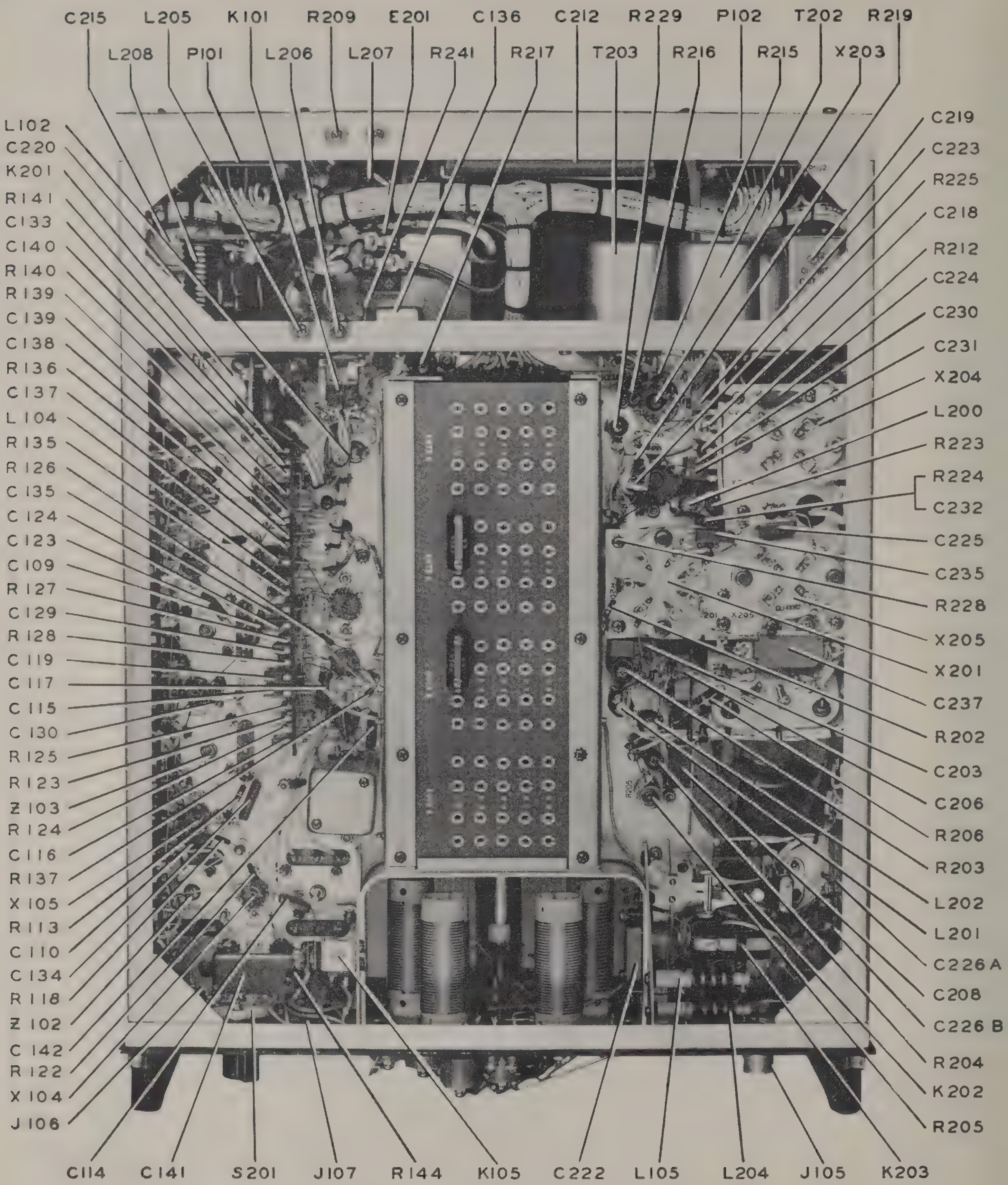


FIGURE 8-2 MODEL 18S , BOTTOM OPEN

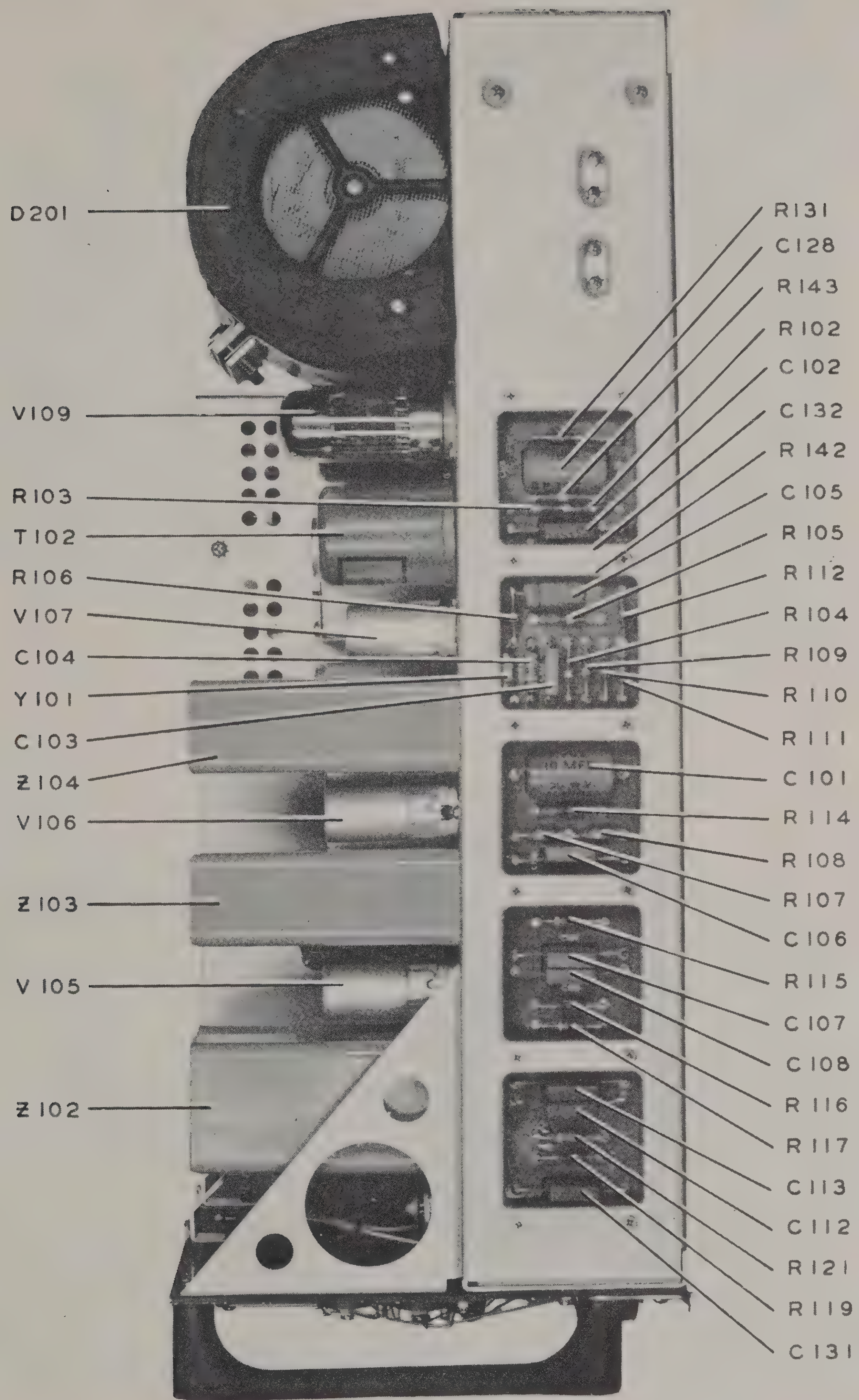


FIGURE 8-3 MODEL 18S , RIGHT SIDE OPEN

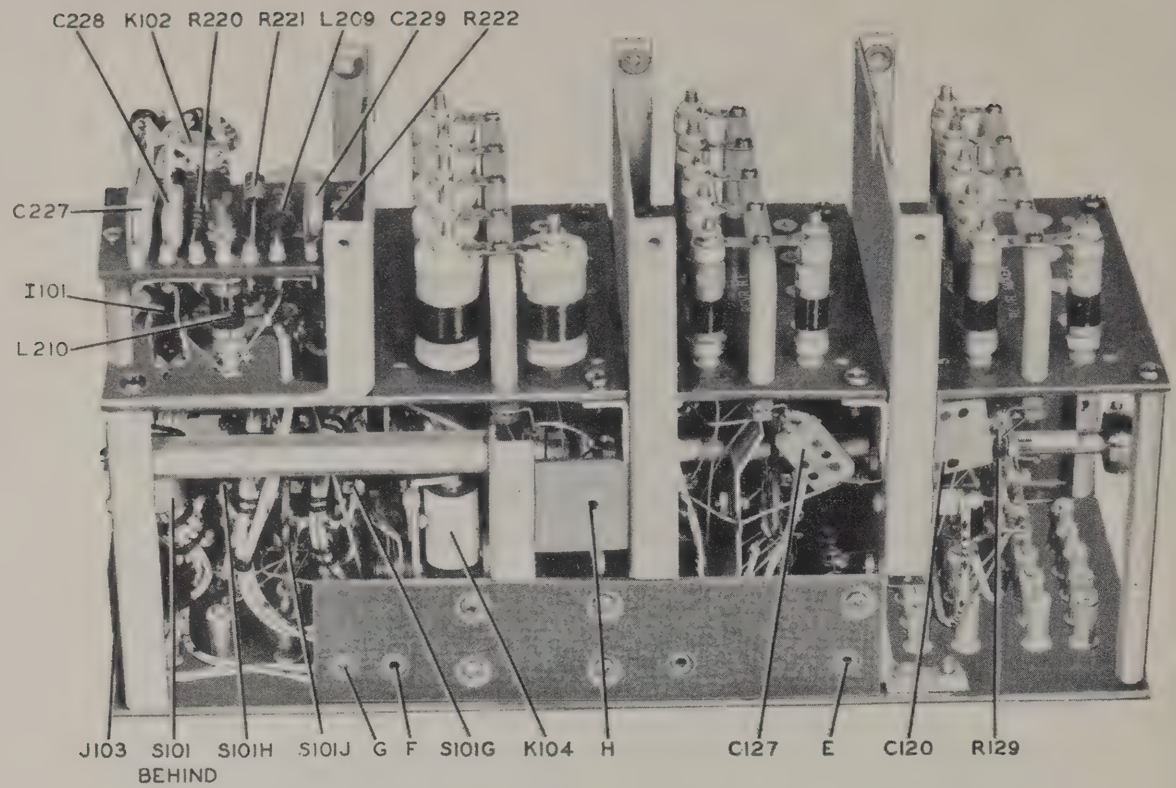


FIGURE 8-4 EXCITER UNIT, LEFT SIDE

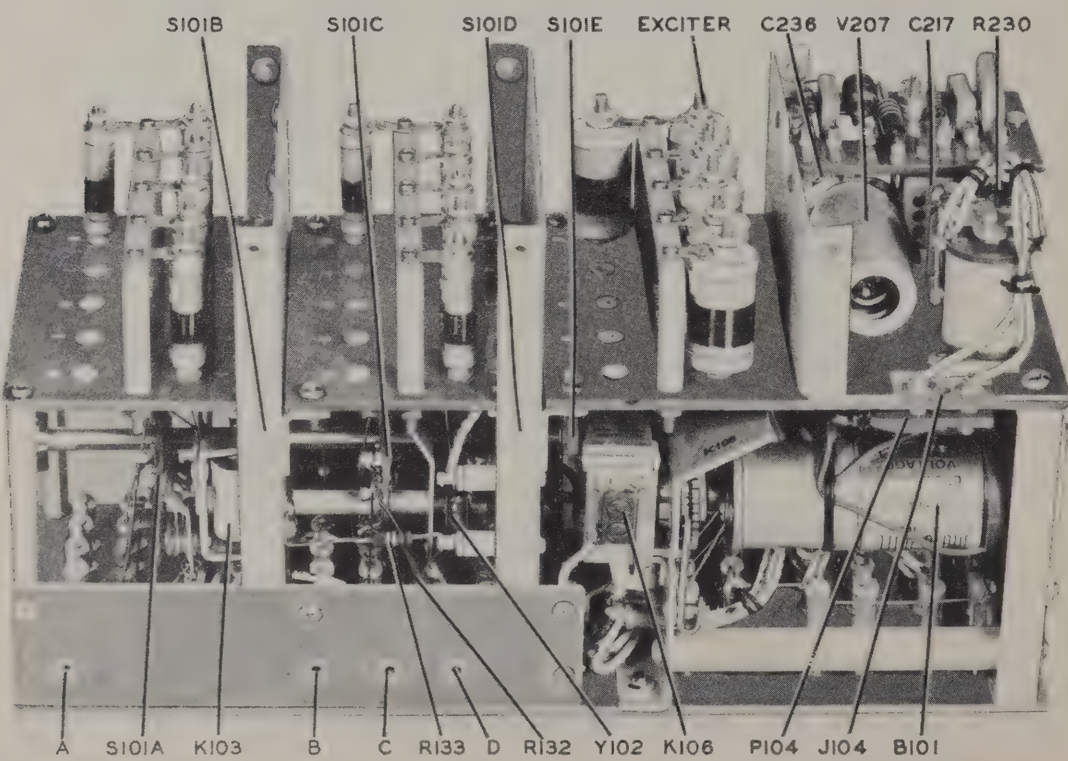


FIGURE 8-5 EXCITER UNIT RIGHT SIDE

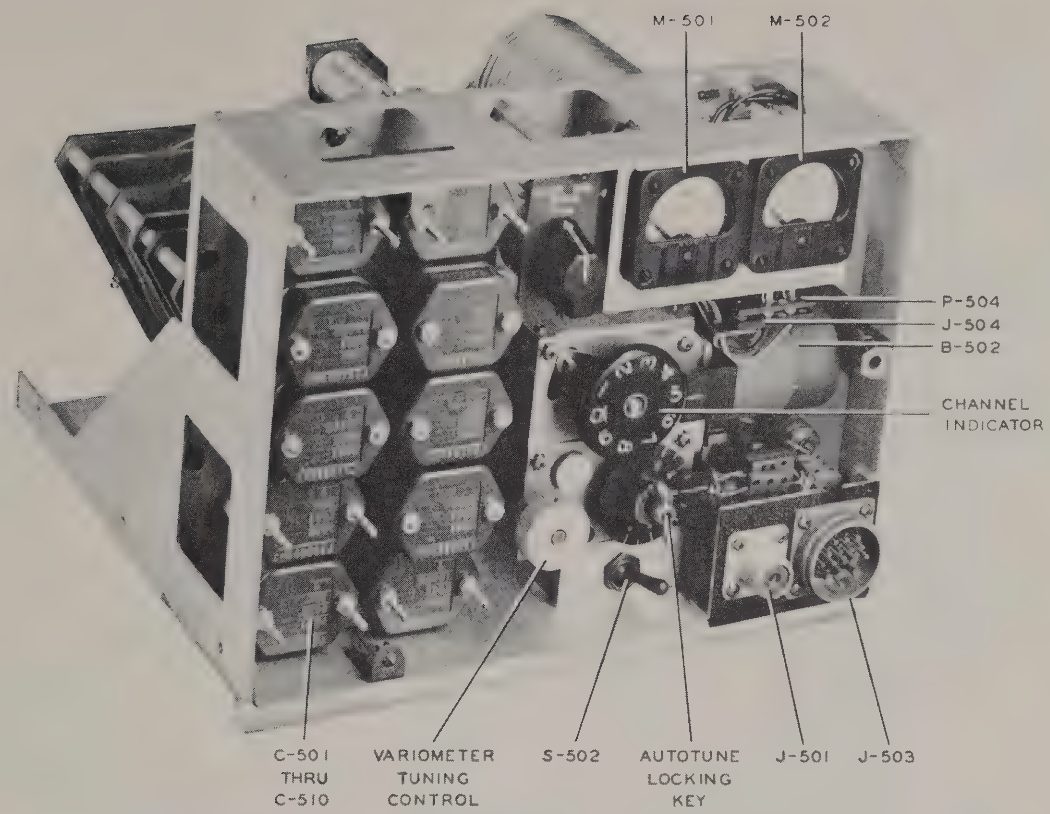


FIGURE 8-6 MODEL 180K-3 ANTENNA MATCHING UNIT, FRONT OPEN

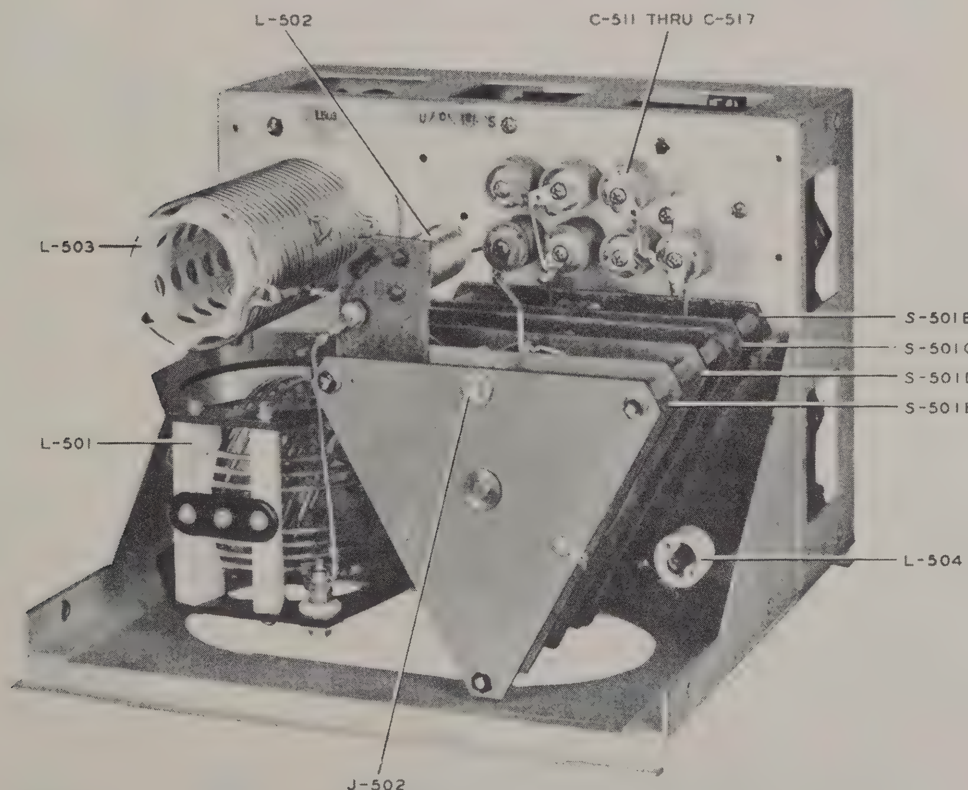


FIGURE 8-7 MODEL 180K-3 ANTENNA MATCHING UNIT, REAR OPEN

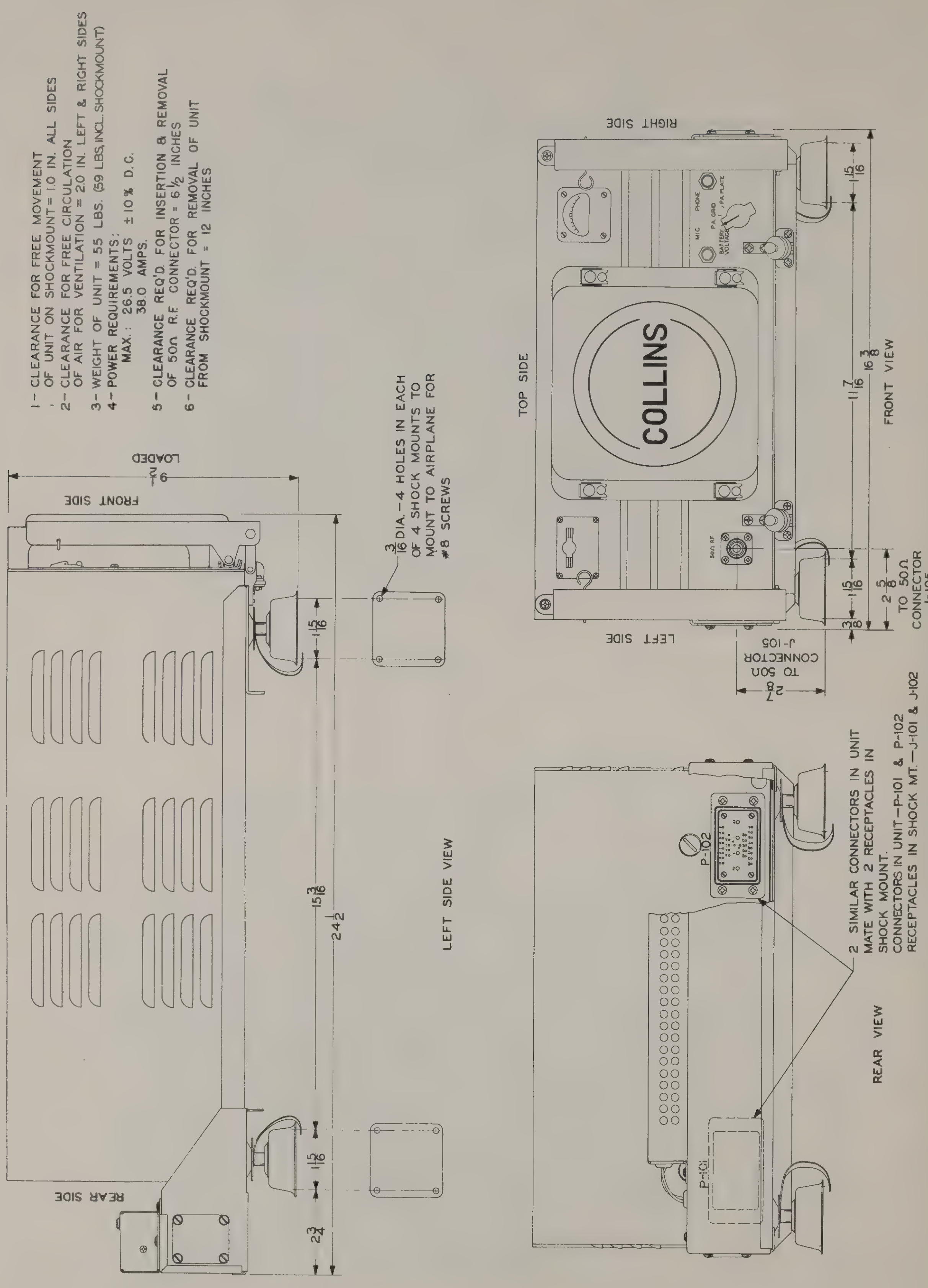


Figure 8-8 Model 18S-4 Installation Diagram

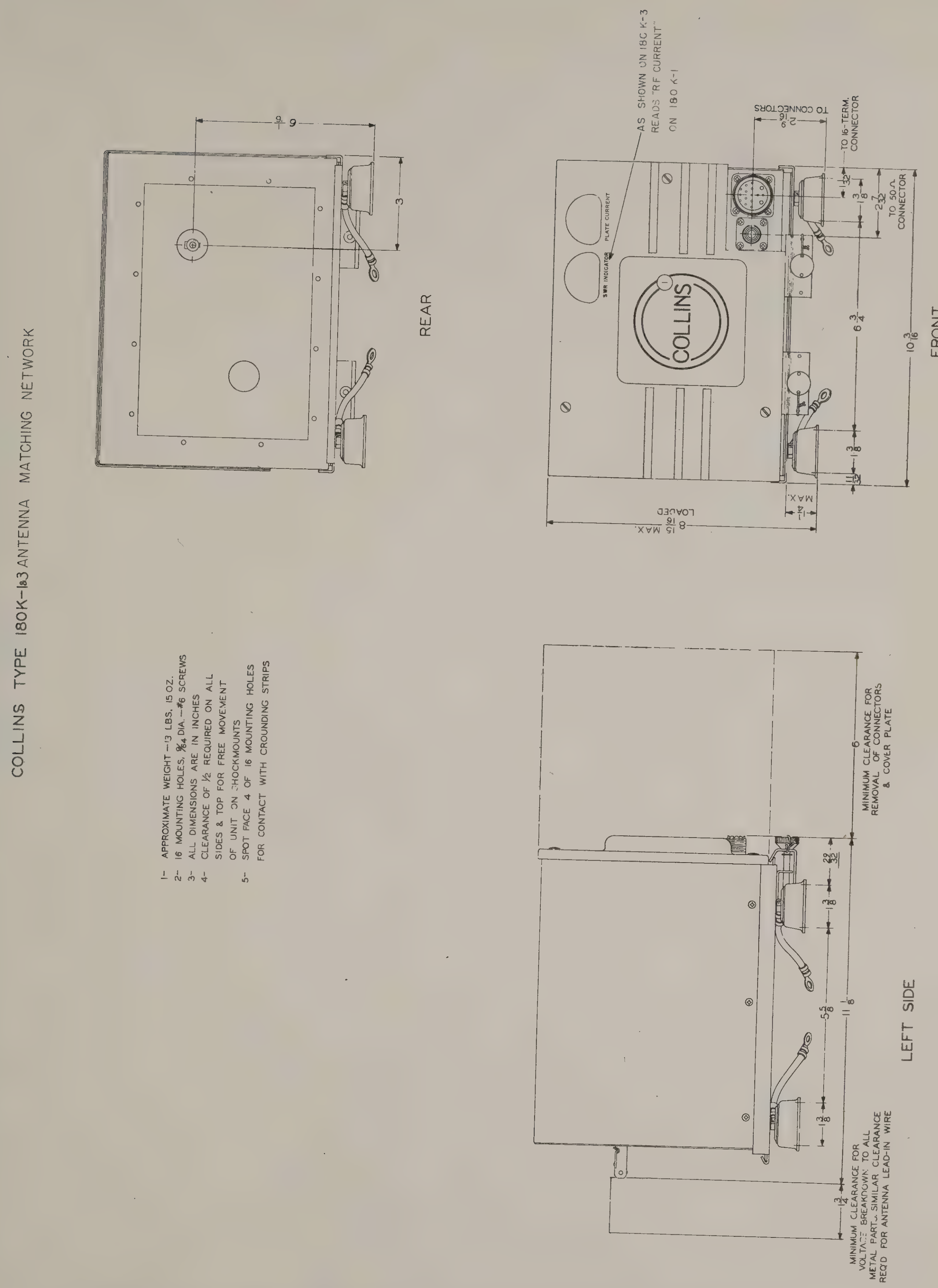


Figure 8-9 Model 180K-3 Antenna Loading Unit Installation

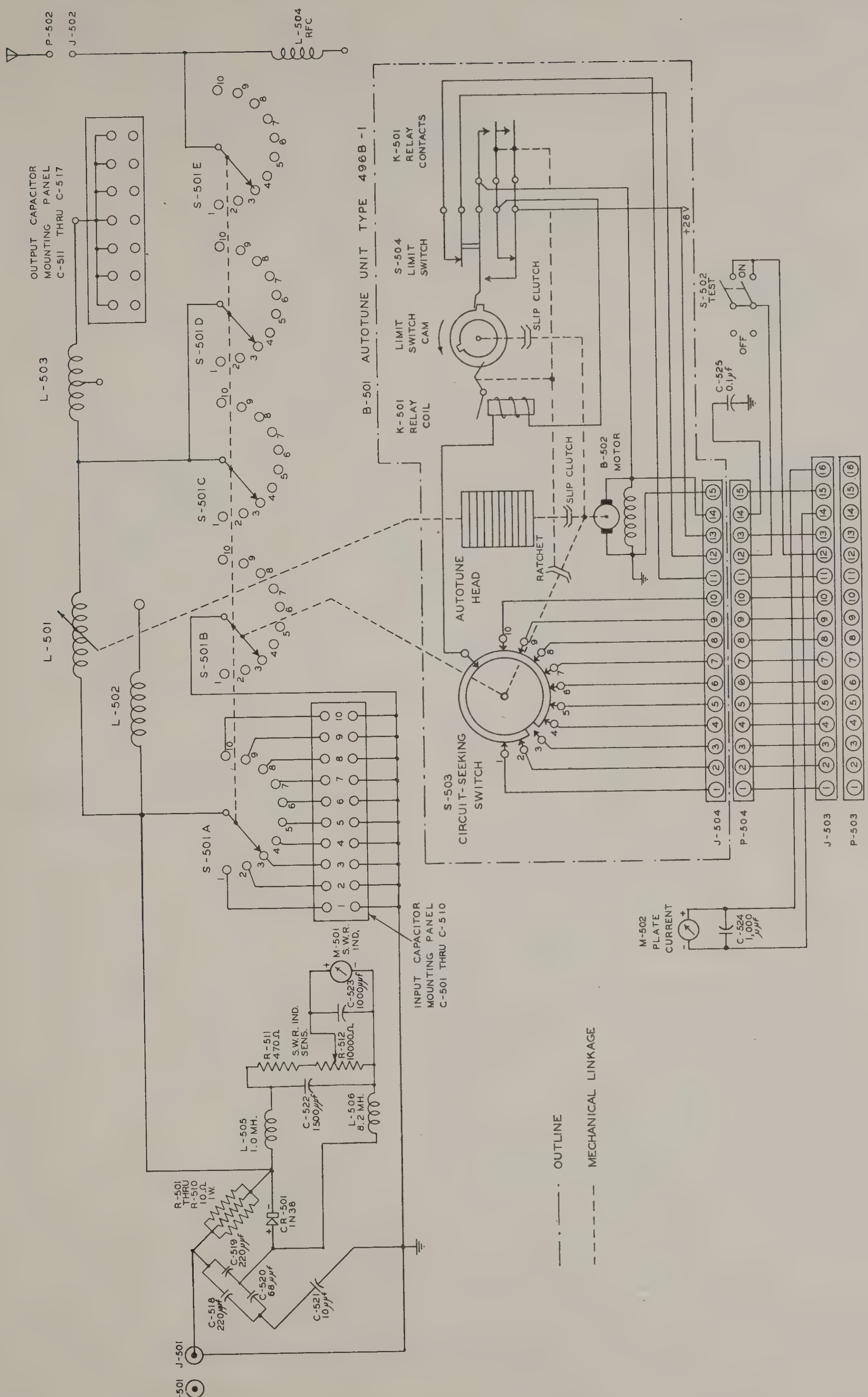
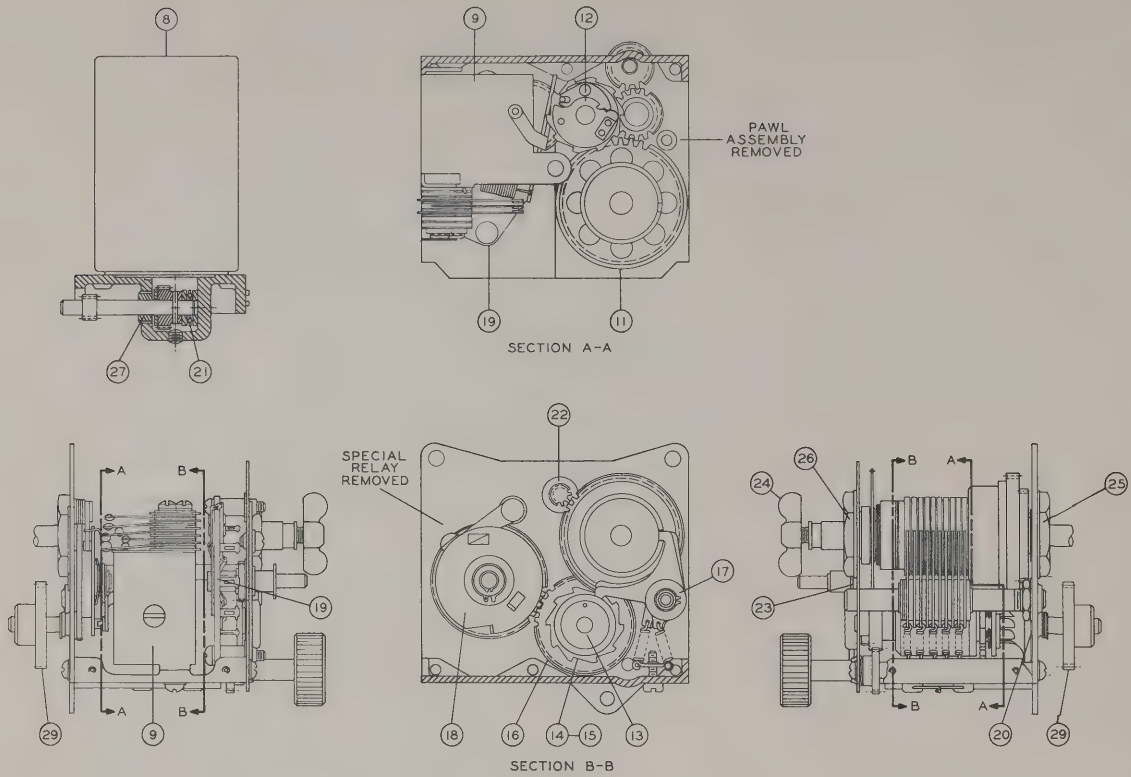
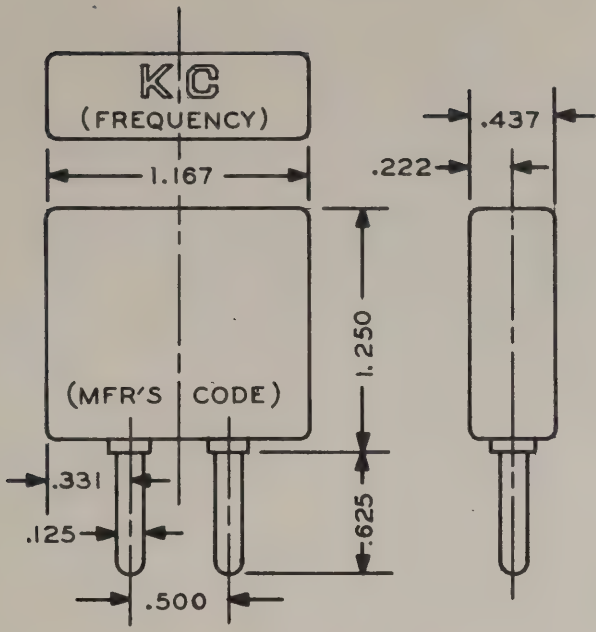


Figure 8-11 Model 180K-3 Antenna Matching Unit Schematic

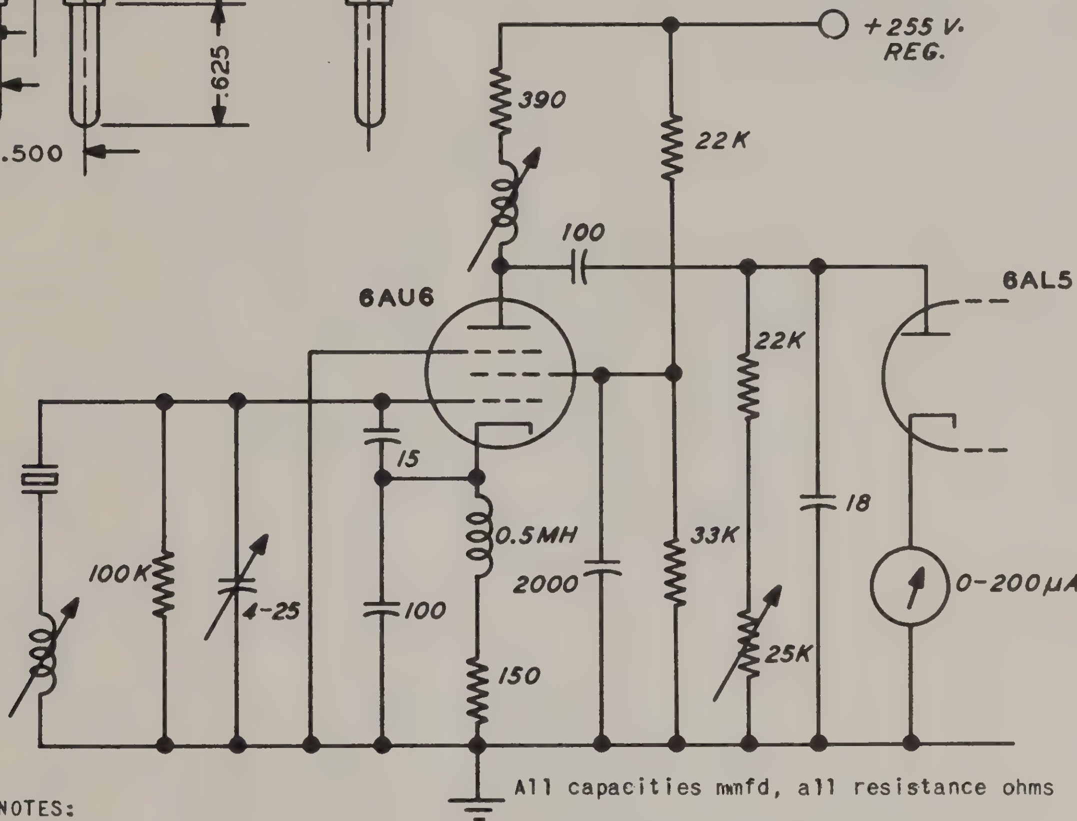


Item	Circuit Function	Description
7	Autotune Head	496B-1
8	Motor Assembly	Motor, Gear and Bracket
9	Relay	Special
11	Stop Ring Shaft Assembly	Stop Ring Shaft, Drum, Band, Gear, Clutch, and Ring Assembly
12	Cam Shaft Assembly	Cam Shaft Assembly, and Gear #1
13	Cam Drum Pin Assembly	Pin Assembly and Drum Assembly
14	Ratchet Latch Assembly	Hub, Pawl, Pins, Spring and Rivet
15	Ratchet Wheel Assembly	Wheel and Pin
16	Cam Drive Gear Assembly	Gear and Bearing
17	Pawl Assembly	Shaft Assembly, Pawl Assembly, Springs, Anchor, and Pins
18	Limit Switch Clutch Assembly	Plate, Spring, Spacer, Ring, Gear, and Shims
19	Seeking Switch	10 Position Switch Pie
20	Bearing	Ratchet Drive Gear Bearing
21	Bearing	Thrust, Upper Casting
22	Bearing	Rear
23	Bearing	Seeking Switch
24	Locking Bar Assembly	
25	Ball Bearing	Rear
26	Ball Bearing	Front
27	Oilite Bearing Assembly	Upper Casting Bearing
30	Stop Ring	
31	Pawl	
32	Pawl Spring	Coil
33	Cam Drum	
34	Line Shaft	Line Shaft, Worm Gear and Spur Gear
35	Slip Clutch Spur Gear	
36	Slip Clutch	
37	Tuning Element Shaft	
38	Seeking Switch Idler Gear	
39	Seeking Switch Drive Gear	

Figure 8-12 496B-1 Autotune Unit Sections



FREQUENCY TOLERANCE: The frequency shall not deviate more than .005% from the nominal frequency over a temperature range of -35 to +70°C in the equipment.



All capacities mmfd, all resistance ohms

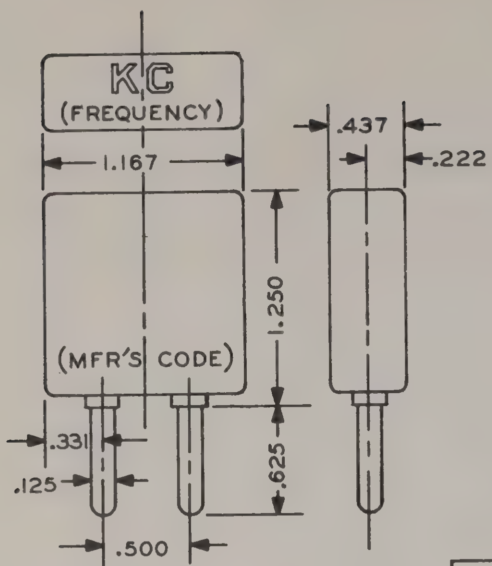
NOTES:

1. At no point in the -35 to +70°C temperature range shall the crystal fail to oscillate and the maximum frequency jump as indicated by deviation from the temperature vs. frequency run curves shall not exceed 0.002%.
2. The input capacity shall be set to 35 mmfd measured at 4.5 mc, with the tubes in, but cold.
3. The minimum rectified diode current shall be greater than 75 ua in the range 2000 to 2500 kc; 100 ua in the range of 2501 to 8000 kc; and 75 ua in the range 8001 to 9000 kc.
4. Either plated wire mounted or pressure mounted crystals may be used.
5. Crystal frequency is obtained for the 18S-3 transmitter as follows:

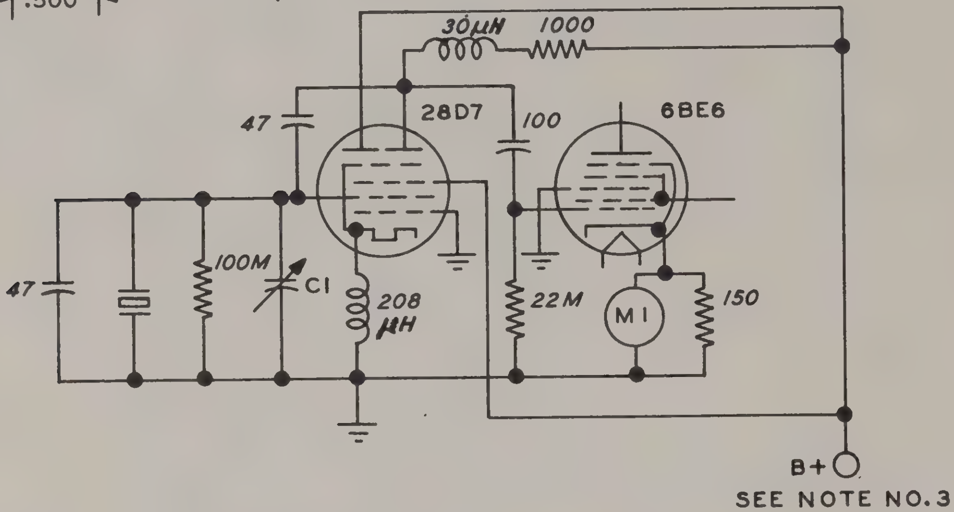
   Xtal Freq = Xmitter freq. between 2 and 6 mc.

   Xtal Freq = Xmitter freq. ÷ 2, between 6 and 18.5 mc.

Figure 8-13 Transmitter Crystal Unit Specifications



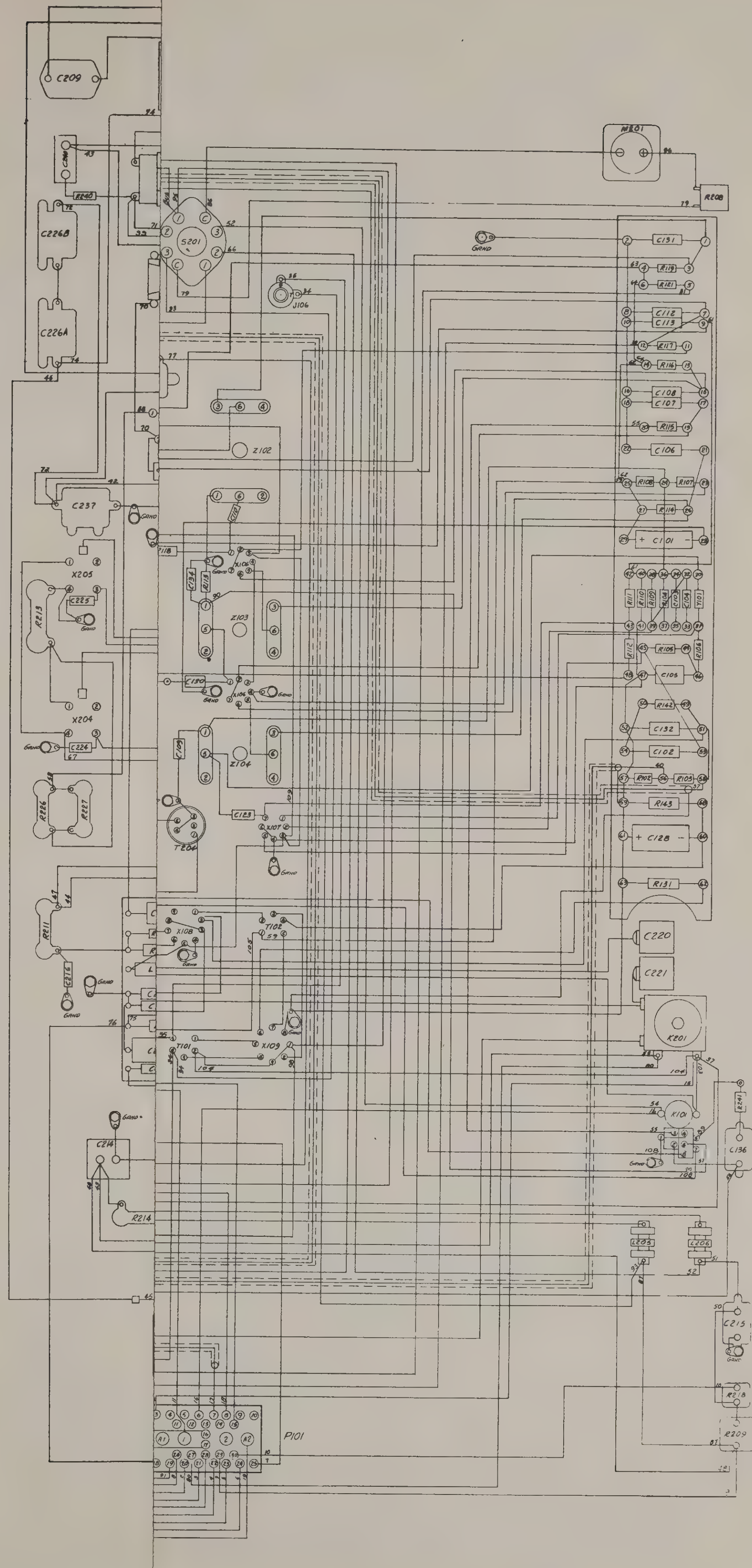
FREQUENCY TOLERANCE: The frequency shall not deviate more than .005% from the nominal frequency over a temp. range of -30° to $+70^{\circ}$C in the equipment.



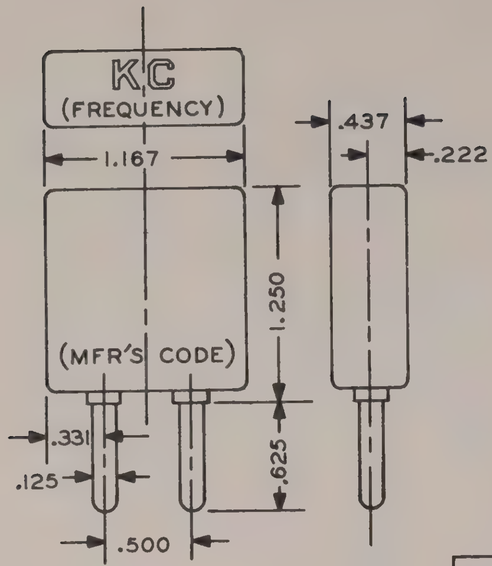
NOTES:

1. At no point in the -30 to $+70^{\circ}$C temp. range shall the crystal fail to oscillate, and the maximum frequency jump as indicated by deviation from the temperature vs. frequency run curve shall not exceed 0.002%.
2. The minimum rectified grid current, as shown by meter M_1 shall not be less than 45 micro-amperes.
3. All tests shall be made at the frequency indicated by the Company purchase order. The crystals are intended for use in an airborne receiver whose B+ voltage may vary from the +22 volts to +32 volts d.c. The crystal test voltage shall nominally be 26.5 volts d.c. and activity, as shown by meter M_1, shall not vary more than minus 20% for voltage changes from +26.5 to +22 volts d.c.
4. The crystal frequency is intended to be an intermediate frequency of 455 kc away from the received frequency. For received frequencies of 2.8 to 7.5 mc high side injection is to be used, using the fundamental crystal frequency. For received frequencies of 7.5 to 18 mc low side injection is to be used, using the 2nd harmonic of the crystal frequency.
5. 18S normal receiver circuit capacity across crystal is 91 mmfd measured at 4.5 mc. C_1 is adjusted to present 91 mmfd to the xtal at 4.5 mc with tubes in place but cold.

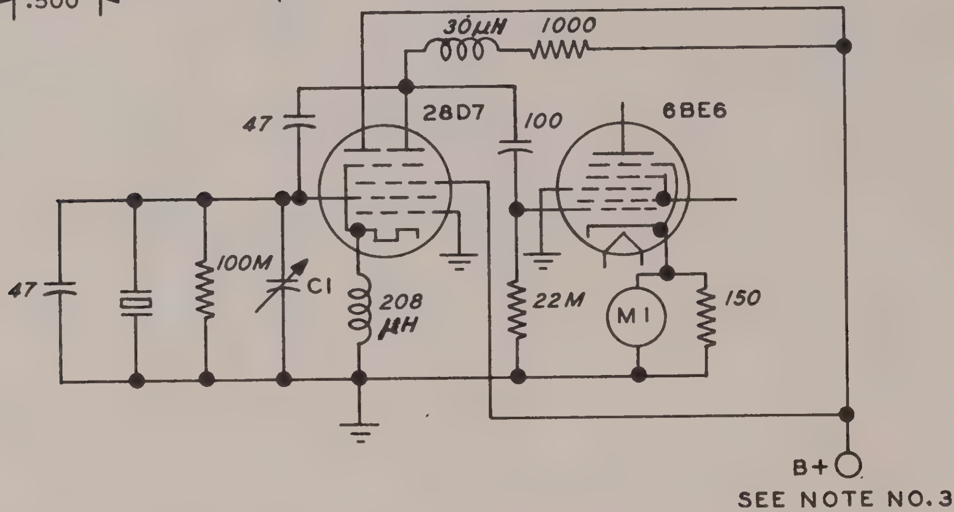
Figure 8-14 Receiver Crystal Unit Specifications



4 Practical Wiring Diagram



FREQUENCY TOLERANCE: The frequency shall not deviate more than .005% from the nominal frequency over a temp. range of -30° to $+70^{\circ}C$ in the equipment.



NOTES:

1. At no point in the -30 to $+70^{\circ}C$ temp. range shall the crystal fail to oscillate, and the maximum frequency jump as indicated by deviation from the temperature vs. frequency run curve shall not exceed 0.002%.
2. The minimum rectified grid current, as shown by meter M_1 shall not be less than 45 micro-amperes.
3. All tests shall be made at the frequency indicated by the Company purchase order. The crystals are intended for use in an airborne receiver whose B+ voltage may vary from the +22 volts to +32 volts.d.c. The crystal test voltage shall nominally be 26.5 volts d.c. and activity, as shown by meter M_1, shall not vary more than minus 20% for voltage changes from +26.5 to +22 volts d.c.
4. The crystal frequency is intended to be an intermediate frequency of 455 kc away from the received frequency. For received frequencies of 2.8 to 7.5 mc high side injection is to be used, using the fundamental crystal frequency. For received frequencies of 7.5 to 18 mc low side injection is to be used, using the 2nd harmonic of the crystal frequency.
5. 18S normal receiver circuit capacity across crystall is 91 mmfd measured at 4.5 mc. C_1 is adjusted to present 91 mmfd to the xtal at 4.5 mc with tubes in place but cold.

Figure 8-14 Receiver Crystal Unit Specifications

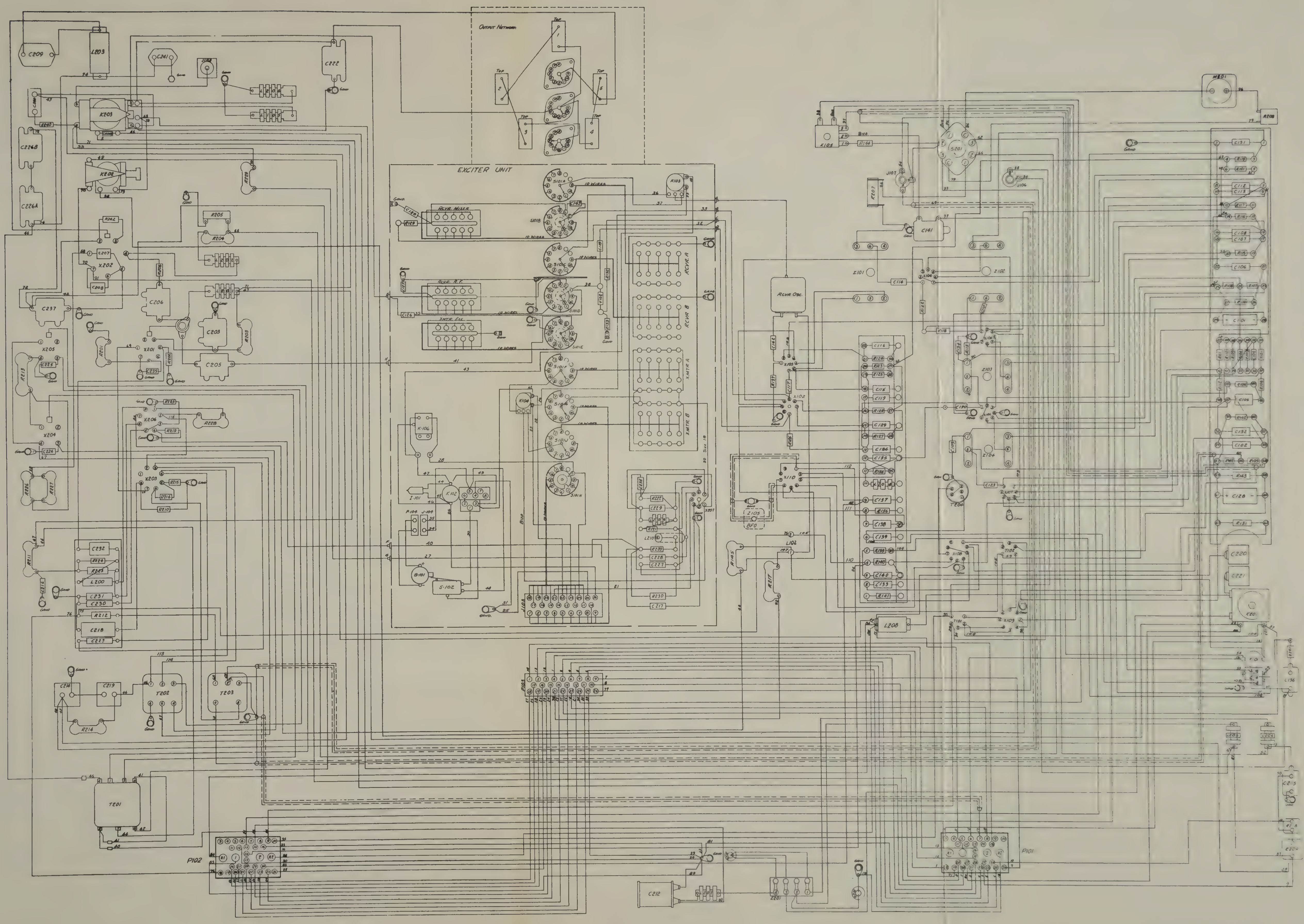
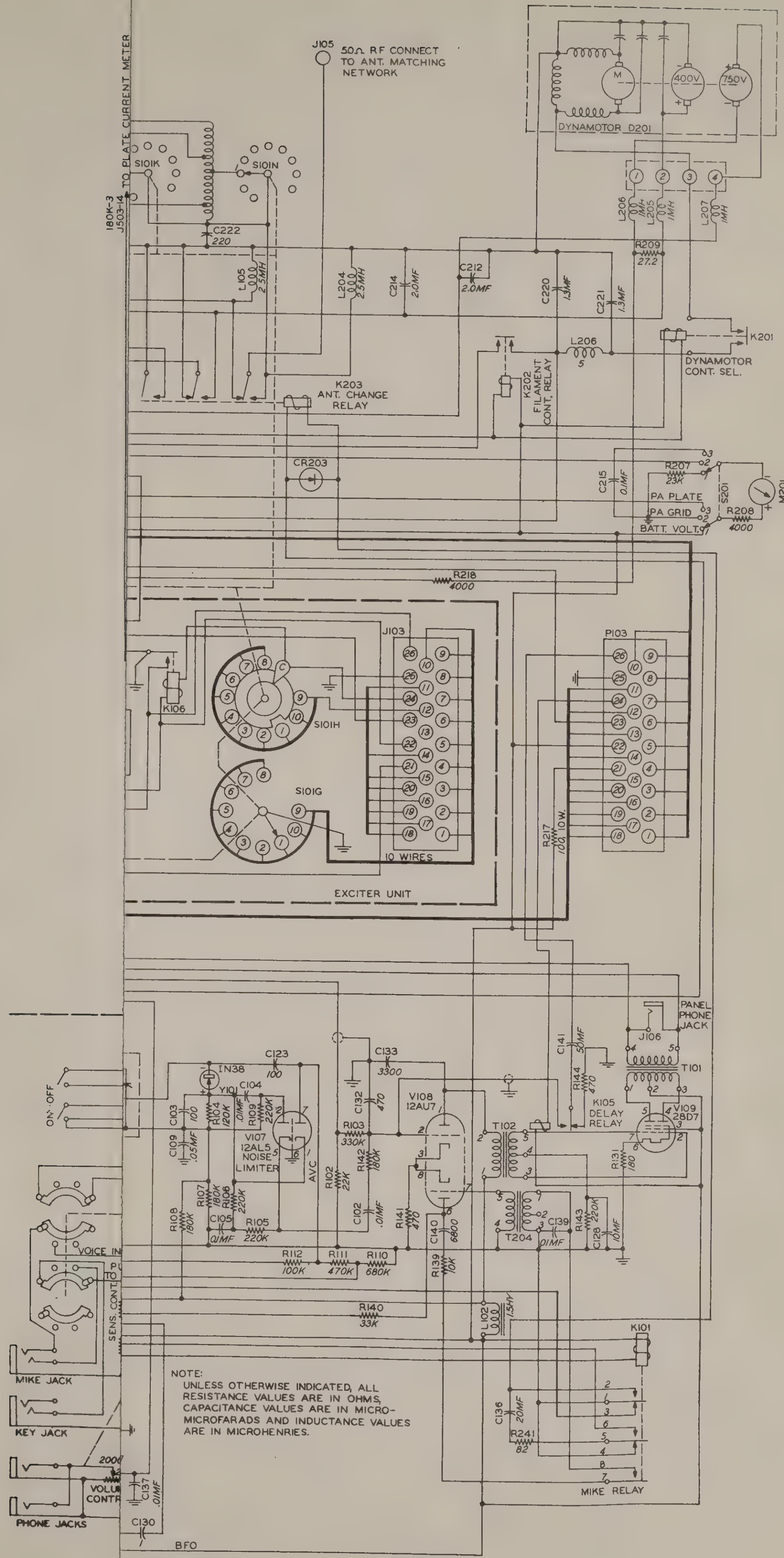


Figure 8-15 18S-4 Practical Wiring Diagram



-10 Model 18S-4 Overall Schematic

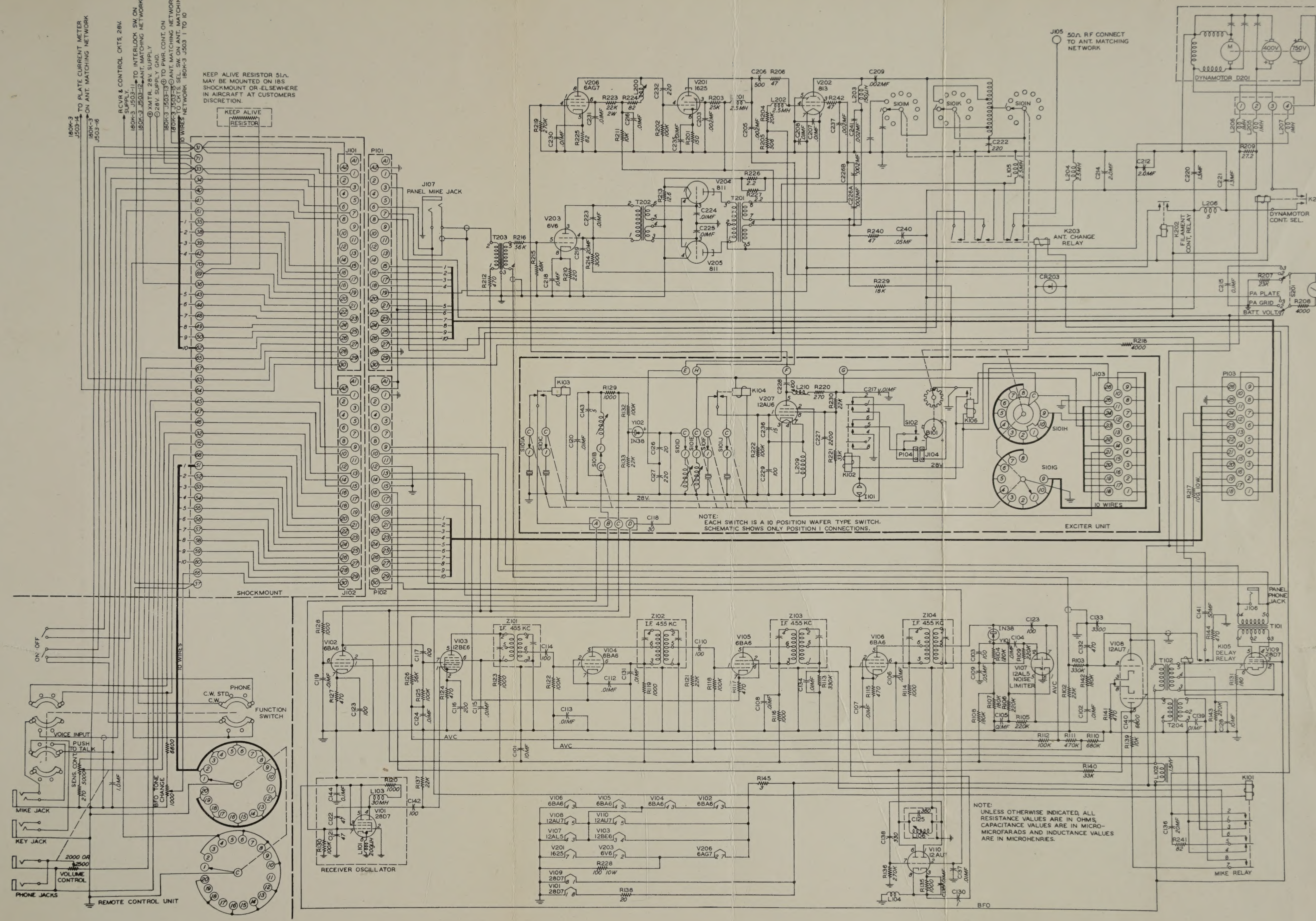


Figure 8-10 Model 18S-4 Overall Schematic